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13. ABSTRACT (Maximum 200 Words) In preparation for the Force XXI (FXXI) Army Warfighting Experiment (AWE), the U.S. Army Experimental Force (EXFOR) (4th Infantry Division), located at Fort Hood, Texas, has been provided a unique synthetic training environment for training units in the use of command and control systems and use of the Tactical Internet. The training environment uses a combination of legacy Simulation Network (SIMNET) devices along with state of the art simulations. Together these systems have provided the EXFOR with the capability to train personnel at various levels. Training scenarios specifically for a digitized force were developed to support the SIMNET-Appliqué training environment. The training scenarios varied from Platoon to Company level. At least fourteen M1 tank and four M2 Bradley simulators are available for training. Each of these simulators has been modified with Appliqué hardware/software as well as radio models [Single channel Ground and Airborne Radio System - Systems Improvement Program (SINCGARS-SIP) and Enhanced Position Location Reporting System (EPLRS)] and position/navigation aids to provide a realistic simulation of the Command, Control, and Communications (C3) capabilities these vehicles will have in the Task Force XXI (TFXXI) AWE. Surrogate nodes consisting of "table-top" Appliqué systems provide additional key nodes as required.				
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**FORCE XXI BATTLE COMMAND - BRIGADE AND  
BELOW (FBCB2) - EXFOR**

**FBCB2-EXFOR #0027**

**CDRL #AB01**

**WHITE PAPER FOR FUTURE IMPROVEMENTS FOR THE FORCE  
XXI BATTLE COMMAND - BRIGADE AND BELOW FORT HOOD  
SIMNET/JANUS WARFIGHTING FACILITY**



FOR: NAWCTSD/STRICOM  
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BY: Lockheed Martin Corporation  
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Information Systems Company  
12506 Lake Underhill Road  
Orlando, FL 32825

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## 1. Scope

In preparation for the Force XXI (FXXI) Army Warfighting Experiment (AWE), the U.S. Army Experimental Force (EXFOR) (4th Infantry Division), located at Fort Hood, Texas, has been provided a unique synthetic training environment for training units in the use of command and control systems and use of the Tactical Internet. The training environment uses a combination of legacy Simulation Network (SIMNET) devices along with state of the art simulations. Together these systems have provided the EXFOR with the capability to train personnel at various levels. Training scenarios specifically for a digitized force were developed to support the SIMNET-Appliqué training environment. The training scenarios varied from Platoon to Company level. At least fourteen M1 tank and four M2 Bradley simulators are available for training. Each of these simulators has been modified with Appliqué hardware/software as well as radio models [Single channel Ground and Airborne Radio System - Systems Improvement Program (SINCGARS-SIP) and Enhanced Position Location Reporting System (EPLRS)] and position/navigation aids to provide a realistic simulation of the Command, Control, and Communications (C3) capabilities these vehicles will have in the Task Force XXI (TFXXI) AWE. Surrogate nodes consisting of "table-top" Appliqué systems provide additional key nodes as required.

This document was prepared in accordance with Data Item Description (DID) DI-MISC-80711 and is the AB01 CDRL for the Force XXI Battle Command - Brigade and Below (FBCB2) - EXFOR Delivery Order of the Advanced Distributed Simulation Technology II (ADST II) program.

This document contains a list of applicable documents and is the White Paper for Future Improvements for the Force XXI Battle Command and Below Fort Hood SIMNET Facility. Appendix A of this document is a vu-graph presentation of the contents of the document.

The document discusses methods for continued usage of these Fort Hood SIMNET Facility systems for future applications. The suggested improvements should allow for improved training capability as well as support concept and technology explorations that will take place in the near future.

This document does not repeat a description of the existing EXFOR training infrastructure or its capabilities. Documentation for these items can be found in the documentation package prepared as part of the original EXFOR Project (Delivery Order 0094 under ADST I) and are listed in the referenced documents and are available through the Configuration Management library of the ADST II program. This paper provides a basic description of potential enhancements to the training capability that currently exists at the Ft. Hood SIMNET site. The areas of interest for this mini-study encompass a large number of technologies and topics. The analysis effort for this white paper addresses these items in an expeditious manner. These items are not being studied in excruciating detail, hence will not provide detailed technical architectures for any potential upgrades. However, the white paper does address the applicability of the technology, general implementation architecture, and a

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concept of operations for each topic. Topics of interest include (a) adding Appliqué to Close Combat Tactical Trainer (CCTT) Quickstart Modules, (b) conducting Battalion level training scenarios, (c) connecting Brigade/Battalion Battle Simulation (BBS) to Modular Semi-Automated Forces (ModSAF) linkage with Appliqué systems, (d) methods for providing additional situational awareness data to the current SIMNET-Appliqué systems, and (e) interconnecting other simulations (Janus) and C4I systems (ATCCS) to the SIMNET-Appliqué training network.

## **2. Referenced Documents**

### *2.1 Government Documents*

None Applicable.

### *2.2 Non-Government Documents*

ADST II - 96-W056 - ADST II Statement of Work for Force XXI Battle Command - Brigade and Below (FBCB2) - EXFOR Fort Hood Simulation Center, dated 26 July 1996.

ADST/WDL/TR--95-W003552 - EXFOR Appliqué Implementation, Step 1 Feasibility Analysis Study of the Force XXI Battle Command - Brigade and Below (FBCB2), dated 14 December 1995.

ADST/LMFS/TR--96-W003690 - EXFOR Appliqué Implementation, SIMNET/Janus Warfighting Facility - Lessons Learned, dated 31 July 1996.

TD 17-6930-702-1, Technical Manual Maintenance Manual for Simulation Networking (SIMNET) Training Device, Device 17-161, US Army, Project Manager for Training Devices (PM Trade), AMCPM-TND-S, Orlando, FL, 32826-3276.

SS-M/V-500D System Specification for NAVSTAR GPS PLGR, April 3, 1995.

Force XXI Operations; TRADOC Pamphlet 525-5, 1 August 1994

## **3. Technical Issues**

As in most developmental efforts, the first version or installation of a system rarely functions exactly as expected and meets all requirements without some modifications. This becomes evident once the system is used on a regular basis. Although the FBCB2 - EXFOR SIMNET/Appliqué system at Fort Hood is functional and has met EXFOR training requirements, there is room for improvement. This section of the document addresses the primary technical issues that exist at the SIMNET/Janus Warfighting Facility at the time of this writing. There are five key issues that are addressed. Improvements are recommended in the following areas:

- **Exercise Administration**
- **Tactical Internet Model**
- **PLGR Model**
- **Simulation Support Systems**
- **Site Maintainability**

Each of the following subsections describes the technical issues, the impact on current site operations and soldier training and provides methods for improving the training situation.

### *3.1 Exercise Administration*

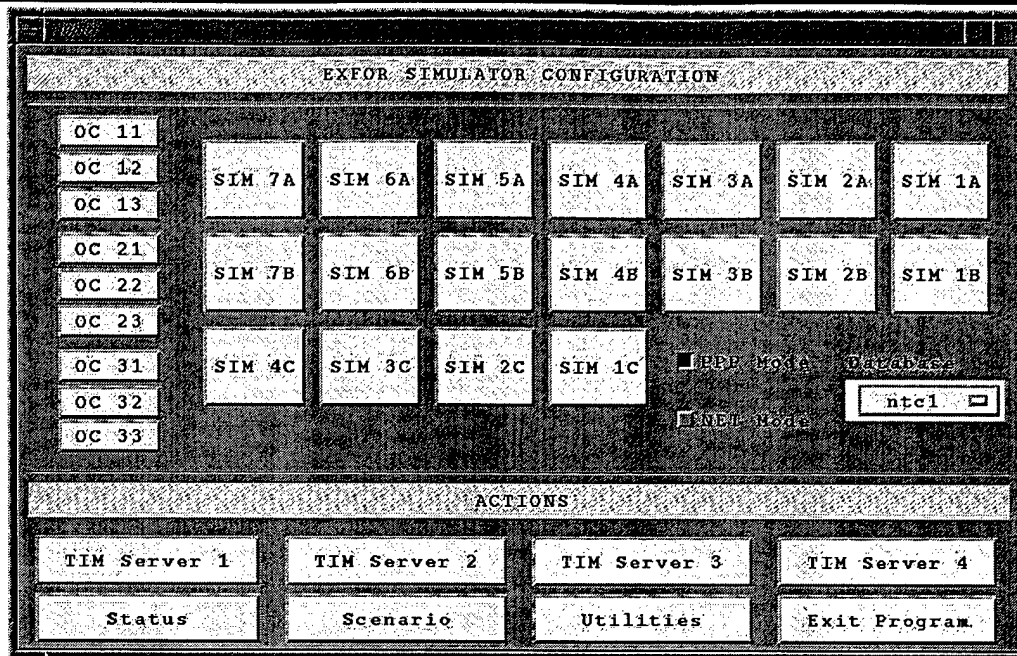
Of the several issues to be resolved at the SIMNET/Janus Warfighting Facility, Exercise Administration seemed to be the most pressing issue. Exercise Administration is the planning, preparation, initialization, conduct, After Action Review (AAR), and shut-down of a SIMNET-Appliqué training session. Currently, this process is assisted with initialization and monitoring tools; however, the complexity of the EXFOR site systems makes Exercise Administration nearly an unmanageable task. Difficulties associated with Exercise Administration have been categorized into Exercise Initialization and Exercise Management. Exercise Initialization tasks are those associated with system configuration and start-up. Exercise Administration tasks are those associated with maintaining system operational status during the conduct of the exercise.

#### **3.1.1 Exercise Initialization**

A conventional SIMNET site has several tools that make the conduct of training exercises manageable by trained technicians and site operations personnel. The EXFOR training environment poses special challenges due to the large number of systems that have been installed to support Appliqué training. Over 100 computers were installed to support communications models, Appliqué interfaces, after action review tools, simulation support computers, and other miscellaneous support systems. Most of these host computers operate from data specific to the unit entity to which they are attached and must be re-initialized for each exercise. These systems are in addition to the SIMNET simulators, ModSAF, Stealth, and SIMNET Management Command and Control (MCC) systems that are a part of a typical SIMNET site. Initialization of each of these computers from their own console is possible; however, the effort and time required to properly initialize these systems for an exercise would be prohibitive. The complexity of this type of an initialization substantially raises the probability for error to occur. To resolve this issue, a custom designed Initialization System was developed under the original EXFOR Delivery Order.



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**Figure 3.1.1-1. Initialization System Main Screen**

The Initialization System allows technicians and operations personnel to configure and initialize systems using a menu-driven user interface. The main screen of the Initialization System is shown in Figure 3.1.1-1. Using the graphical user interface, an operator can select system configurations for all nodes and sub-systems on the training network. The Initialization System starts a series of scripted configuration and boot commands using remote log-ins to each computer on the site networks. The initialization process establishes the relationships between the Appliqué, its simulated host vehicle or fixed operating location, and the identity of its user, so that the simulation properly replicates the behavior of Appliqué as it would operate in the real world. This process requires careful attention to detail and proper planning and coordination between the Observer Controllers (who plan the exercise) and the technicians/operations personnel (who initialize the systems). More often than not, the initialization process can be completed without too many technical difficulties. However, there are many times when the systems are not initialized properly due to the excruciating detail and care that must be used when setting up an exercise. To help remedy this situation, there are improvements that can be made to the Initialization System to improve upon the existing initialization procedure. The following improvements will help resolve existing exercise initialization issues:

- **Enhance user-friendliness of the Initialization System.**
- **Refine the Scenario Manager Shell within the Initialization System.**
- **Provide the capability to electronically transfer data from the ModSAF scenario files to the Initialization System.**

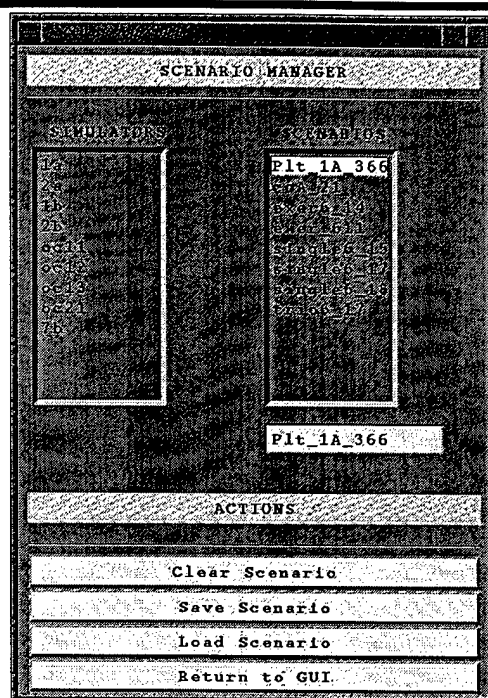
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The first suggested improvement for the Exercise Initialization process is to enhance the user-friendliness of the Initialization System. In specific areas of the initialization process, the Initialization System requires that the user follow a specific sequence of events and also wait specific time intervals between steps, otherwise initialization may fail. Modifications can be made to include software constraints that would render certain selections inactive until the required time interval is completed.

On-line help is a functionality that does not exist in the Initialization System. This capability would help guide the user through the initialization process and would assist in better understanding the Initialization System. On-line help can be implemented in a number of different ways. One is to import the site documentation (Appendix J of the SIMNET/Janus Warfighting Facility - Lessons Learned Documentation - see references) into the Initialization System. This would allow electronic access to the system description document. Each selection can be linked to the respective section within the document that describes the selection's functionality. Another method for providing on-line help is the inclusion of dialog boxes prompting the operator when to perform actions and also warning the operator before incorrect actions are selected.

The second enhancement for Exercise Initialization is to improve the Scenario Manager Shell within the Initialization System. The Initialization System allows a user to save initialization parameters to a scenario file for later use by entering the Scenario Manager Shell. A scenario consists of a list of simulators and the parameters necessary to reconfigure the attached host machines. When the user clicks the scenario button on the Initialization GUI main window, the Scenario Manager Shell, illustrated in Figure 3.1.1-2, appears.

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**Figure 3.1.1-2. Scenario Manager Window**

This capability is useful because it saves time on re-programming of scenarios if they are to be repeated. The Load Scenario function will automatically re-initialize systems under the conditions of the saved scenario. However, the utility of this function is limited because the Scenario Manager will not allow a user to make modifications to a pre-existing scenario. This requires that the exact equipment (i.e., simulators) and roles be played as they were in the original scenario. This proves to be quite limiting since equipment availability varies from day to day at the site. This enhancement would be a simple upgrade and would have significant added value to the exercise initialization process.

The final suggested improvement for Exercise Initialization is to provide a mechanism for electronic transfer of data between the ModSAF scenario files and the Initialization System. This mechanism would give the Observer/Controllers (O/Cs) the capability to directly transfer scenario initialization data to a file that can be transferred directly to the Initialization System. Data required by the initialization system that can be provided includes vehicle bumper numbers, vehicle locations, and terrain database.

### **3.1.2 Exercise Management**

A SIMNET-Appliqué simulation exercise is managed by the O/Cs using several tools [ModSAF, Simulation Training Integrated Performance Evaluation System (STRIPES), a SIMNET Stealth, and the AAR Direct Audio / Visual (A/V) system]. These systems can monitor an exercise in real-time, and under the O/C's control, can help manage the flow of battle to suit the training objectives. The management of a SIMNET-Appliqué exercise is difficult for many of the same reasons that Exercise Initialization can be problematic. There

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are a large number of complex systems interacting to provide this unique training environment. There are two areas where Exercise Management can be improved.

- **Provide a mechanism for automated fault isolation and fault recovery.**
- **Provide a "Tactical Internet Stealth" capability.**

The automated fault isolation and fault recovery system concept would monitor system status using the site's initialization / maintenance network [also known as the "Variable Message Format (VMF) Network" since it is the "backdoor" network used by the Appliqué's to transmit VMF messages when the Tactical Internet Model (TIM) is not available] and report system failures to alert technicians and operations personnel when a system has failed. There is currently limited functionality within the Initialization System to monitor status of the Appliqué and the Precision Lightweight Global Positioning System (GPS) Receiver (PLGR) systems.

Another tool that may enhance Exercise Management is a Tactical Internet Stealth (TIS). A problem with conducting a simulation exercise with realistic communications models is it is very difficult to differentiate between a communications failure due to communications model effects and a communications failure due to a system failure unrelated to the training exercise. The TIS is a concept that would alleviate some of these difficulties by providing a graphical representation of the Tactical Internet, and graphically depicting communications links and radio transmissions. This system could be used by Observer/Controllers, technicians, and operations personnel to visualize battle conditions and the effects of the synthetic environment on tactical communications. The TIS concept is to display a two dimensional representation of the tactical communications exercise. An example of what a TIS graphical user interface might look like is illustrated in Figure 3.1.2-1.

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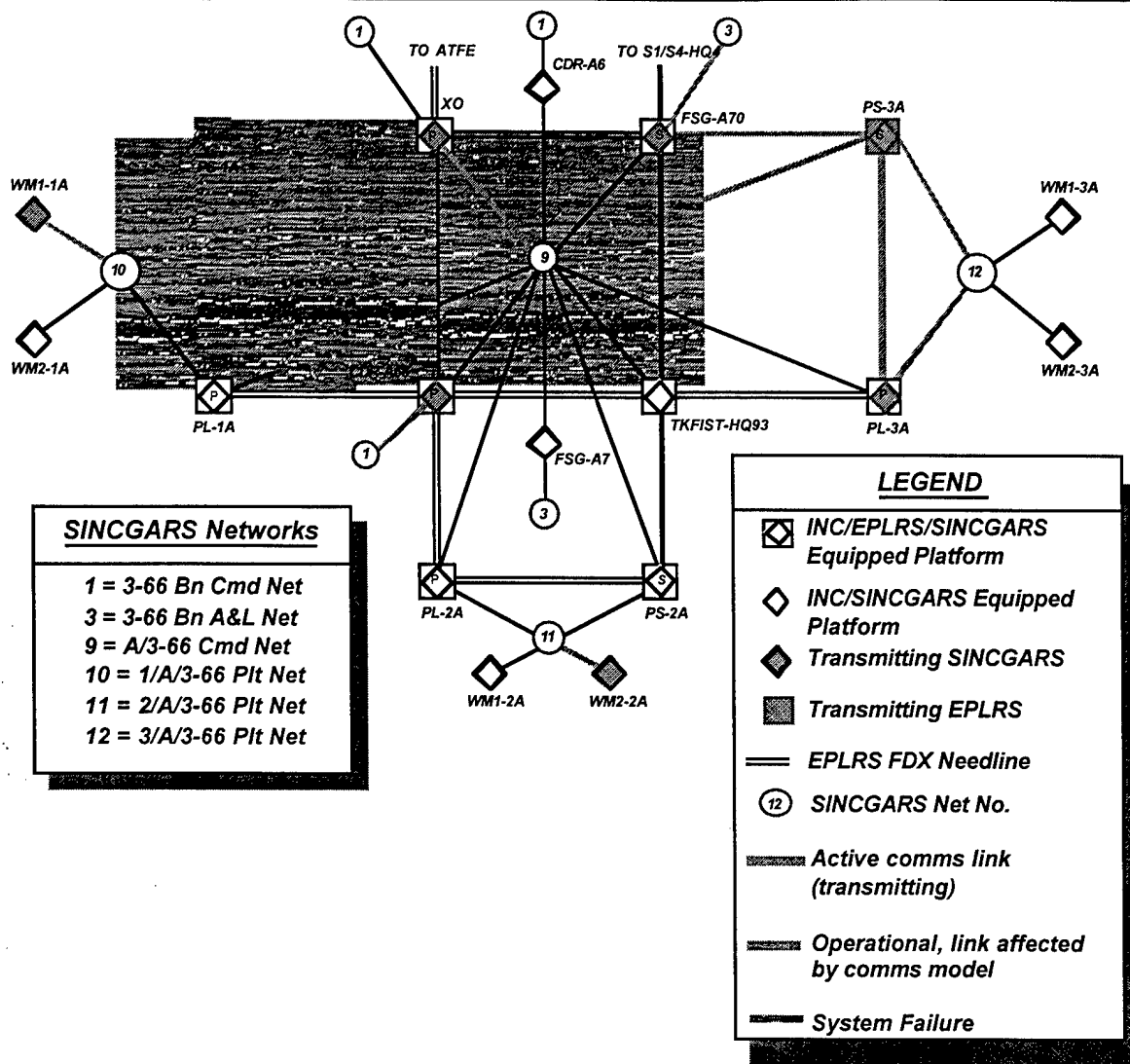


Figure 3.1.2-1. Example of Tactical Internet Stealth Graphical User Interface

For the actual Tactical Internet Stealth, the lines and graphics would use colors, instead of using patterns and shading. The TIS functionality may include:

- System status (whether the simulator's radios are operational or not). This can be graphically represented by a shaded box around the particular node when the radios are initialized and functioning properly.
- Link status (whether a radio is transmitting or is idle). This can be represented by lines that indicate the network topology. When a radio is keyed for transmission, the appropriate network lines can change from black lines (denoting that the network link is functioning, but idle) to slashed lines (denoting that the radio is transmitting).
- Communications effects (whether a system is operating properly, but is unreachable due to communications effects). The network lines can be

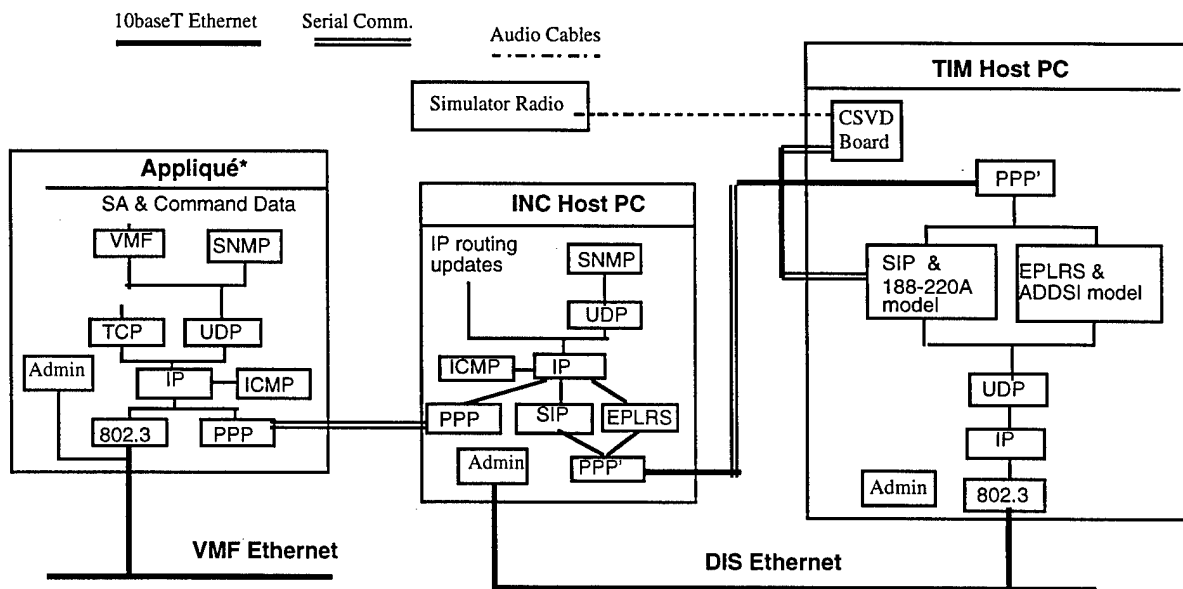
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**modified to display another pattern (diamonds) when a transmission is unsuccessful due to communications effects.**

Exercise Management provides significant challenges to the site personnel. The ability to quickly isolate and repair faults as well as visibility into the effects of simulation models (TIM) would greatly reduce operational issues and provide for more efficient training.

### 3.2 Tactical Internet Model

Theoretically, the simulation environment does not allow for actual Radio Frequency (RF) radios. To operate properly in a Distributed Interactive Simulation (DIS) network, the radio traffic must be converted into DIS Transmitter and Signal Protocol Data Units (PDUs). This is accomplished by the TIM. The TIM consists of an Internet Controller (INC) computer and a TIM computer for each Appliqué system, as well as some supporting systems. As shown in the figure below, the TIM host computer also includes the simulation components that model the components of the real world system.



**Figure 3.2-1. TIM Communications Implementation**

#### 3.2.1 TIM Implementation

Although the Tactical Internet has proven to be a robust and realistic software model there are still several items that could be improved for exercise configuration and operation. The enhancements to the Tactical Internet Model that will assist in configuration and diagnostic procedures are:

- **Receiver PDUs:** DIS Receiver PDUs are used to indicate when a radio has received or is receiving signal PDUs. The addition of DIS Receiver PDUs would allow a limited real time monitoring of radio communications. The addition of Receiver PDUs is an essential upgrade for the development of the Tactical Internet Stealth (TIS).

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- DIS compatibility testing: Currently the TIM has not been tested for DIS compatibility but some bugs are known to exist. There is one known bug that should be corrected: the size of a Signal PDU is not supplied in the DIS PDU. The TIM software does not rely on this field, so no adverse effects are noticed. As the TIM environment is populated and monitored with other systems, such as data collection and real time analysis tools, these issues will become significant.
- Soldier-Machine Interface (SMI) (face plates). Currently the radio nets and frequencies are set at run time. Once an exercise is up and running the operator has no interface to affect the operation of the device. Applications such as CCTT simulators may wish to utilize such an interface to support the higher level of fidelity of their simulations.

### 3.2.2 Digital Voice Implementation

The Tactical Internet Model was designed to support Digital voice communications. The SIMNET simulators operate with Citizen Band (CB) radios. When the TIM was integrated into the SIMNET vehicles, an interface was designed that would allow the Digital Audio system of the TIM to interface to the SIMNET vehicle's headsets, microphones, and push-to-talk switches. Due to impedance mismatches and gain levels of the two systems, the interface was never fully integrated. An amplifier circuit was designed to allow the systems to be integrated, but integration of these circuits was not fully tested or completed as part of the original EXFOR Delivery Order. The amplifier circuit requires a quick disconnect interface to one of the cards in the radio card cage before it will support switching between CB radios of the SIMNET vehicles and Digital audio of the TIM.

### 3.3 Precision Lightweight Global Positioning System (GPS) Receiver (PLGR) Model

The PLGR model has had several modifications over the past few months which have made the model more reliable and operationally effective. There are two enhancements that would allow the site technicians and operations personnel to better control the PLGR model during an exercise.

The first enhancement is to provide for remote re-synchronization of a PLGR Model. An option should be added to the PLGR that allows the operator to re-synchronize the PLGR model to its respective Appliqué by using the Initialization System. Currently, if the PLGR goes out of synchronization with the Appliqué, the operator must perform a manual reset to the PLGR. This is an intermittent problem that has been observed and is usually related to problems with Appliqué initialization.

The second enhancement, which would also remove a burden from site technicians and the operations personnel, is to have the PLGR remotely report the position of the entity it is attached to. Currently, if the operator suspects a problem with a PLGR he must first, verify the position of the entity that the PLGR is attached to [via ModSAF Planned View Display (PVD)] and then walk to the PLGR and manually check the position reported by the PLGR.

### *3.4 Simulation Support Systems*

#### **3.4.1 Exercise Observation and After Action Review Capabilities**

Since much of the EXFOR virtual simulation training focuses on integrating the use of Appliqué into unit tactics, techniques and procedures, a means has been provided to allow Observer / Controllers (O/Cs) to observe, record, annotate, and replay Appliqué activities. This capability is resident in the AAR system that is provided to augment the O/C workstation. Suggested improvements to the exercise observation and AAR systems are needed in two areas; data collection/presentation and after action review.

##### *3.4.1.1 Data Collection and Presentation*

There are three outstanding issues/enhancements regarding data collection and presentation.

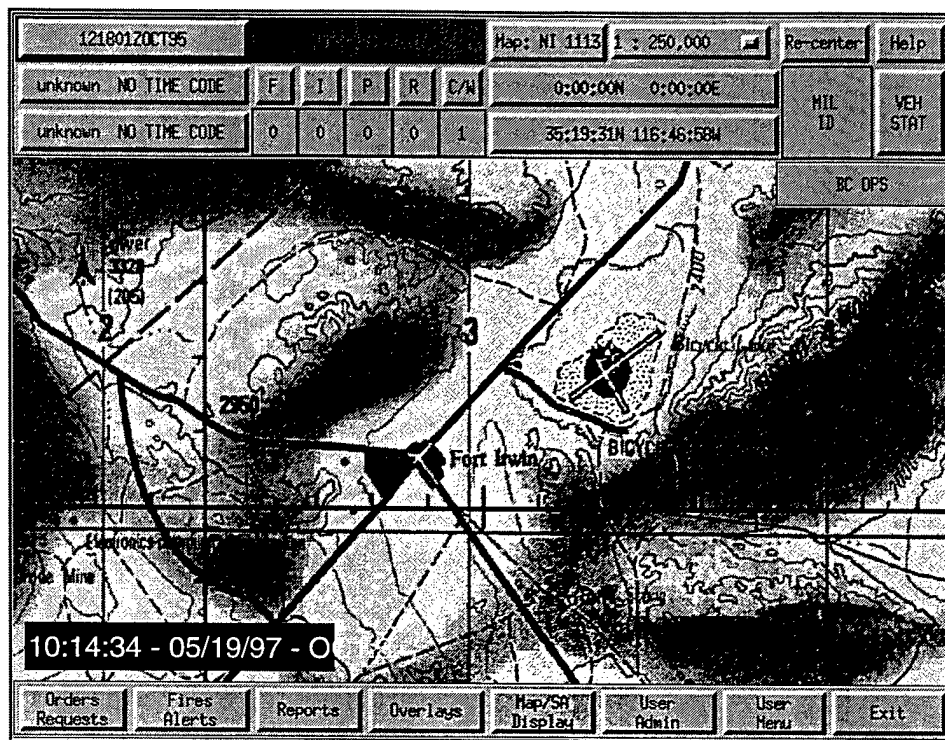
- **STRIPES data logging does not support logging voice traffic from the CB radio systems.**
- **The Appliqué video recording system should be enhanced to include an overlaid timestamp and exercise identification label.**
- **Develop automated AAR tools that are applicable to "digital" Training Support Packages (TSPs) and assist in training Tactics, Techniques, and Procedures (TTPs).**

Logging voice traffic from CB networks is required for training exercises that use the conventional SIMNET radio networks. The legacy SIMNET radio system uses CB radios interconnected on a "RF Local Area Network (LAN)" system to communicate between exercise participants. The CB radio capability was not removed from the Fort Hood site SIMNET simulators to allow for conventional unit training (training without Appliqué and without the TIM). The STRIPES logger does not support analog-to-digital conversion and storage of voice signals. Providing this capability may be a priority if a significant amount of conventional training is to be performed at the SIMNET/Janus Warfighting Facility. One approach to correcting this issue would be to incorporate the ModSAF Logger's voice logging capability into STRIPES. Another approach, although only recommended as a short term solution, is to host both the ModSAF logger and the STRIPES logger on the same system. This second solution will require porting the ModSAF logger to a more recent version of the Silicon Graphics Incorporated operating system (SGI/IRIX). Both loggers operate on SGI hosts, however, their Operating Systems are different versions.

The second data collection/presentation enhancement is to place a label with time and exercise number overlaid onto the video recording of each Appliqué screen. This will make it easier for an observer to note a time of an event and return to that point in time if the event isn't logged on the AAR System or if the video recording is being viewed as a take home package. Figure 3.4.1.1-1 illustrates this concept.



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**Figure 3.4.1.1-1. Concept for Appliqué Timestamp**

The labeling scheme would have to be determined. The example above, shows the Appliqué screen recorded at 10:14:34 a.m. on May 19, 1997, recorded in O/C Room number 1, on Exercise 3.

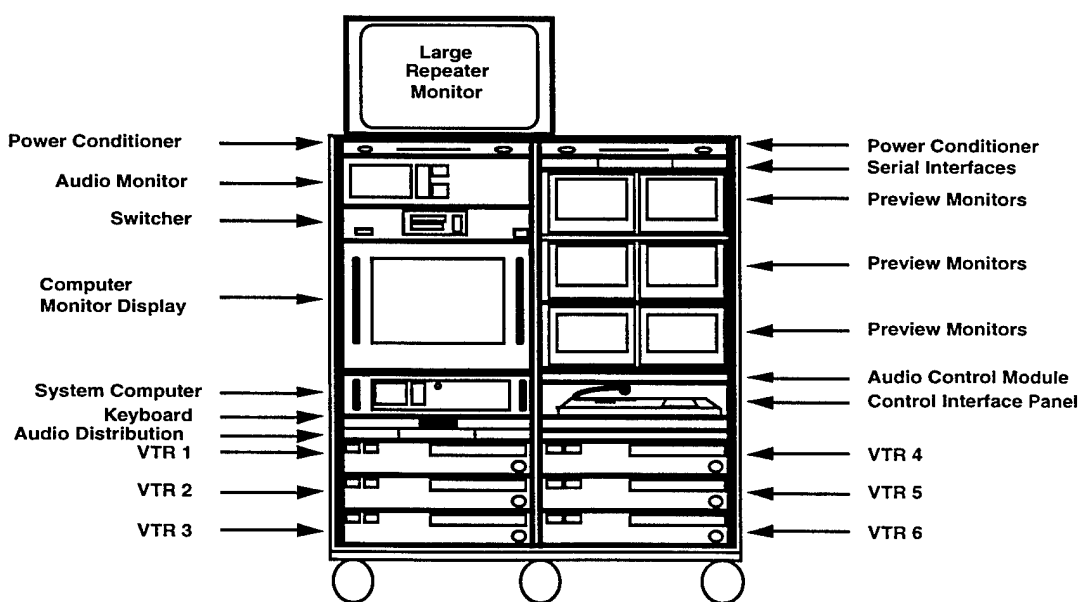
The final recommendation is for development of automated AAR tools applicable to digital training. The STRIPES System will provide automated feedback for conventional units, however, the capability to derive automated data from Battle Command (BC) and Situational Awareness (SA) traffic could be supported with a reasonable development effort. Technically, it is very feasible to modify STRIPES to perform automated collection, reduction, and analysis of BC and SA data. Several examples of this capability are shown in the table 3.4.1.1.-1.

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**Table 3.4.1.1-1. Sample of Automated Data Collection, Reduction, and Analysis**

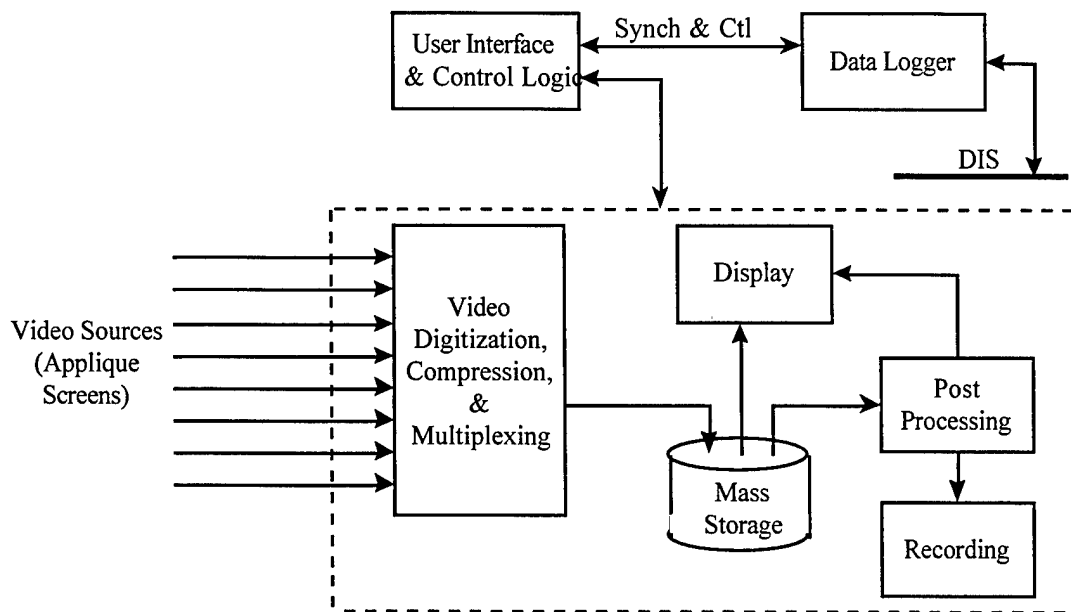
<b>Data Element</b>	<b>Method of Collection</b>	<b>Sample Data</b>
How accurate were the Spot reports sent by 2 <sup>nd</sup> PLT LDR of Alpha Company?.	Collect all Spot Reports sent by 2 <sup>nd</sup> PLT LDR's Appliqué on the DIS network. Examine the reported locations and vehicle types for the observed vehicles for all Spot Reports. Compare this information to the "ground truth" data found in the DIS PDUs and automatically determine the deltas.	Bumper No: A21 Spot Report Accuracy: 90% Spot Reports Sent: 10 Spot Reports within tolerance: 9 Erroneous Spot Reports: 1 Msg 1: DTG 211014 Error: Reported observed T72, actual vehicle was a BMP
Was the Operations Overlay (originally sent by an O/C room Appliqué, acting as a Company Commander) forwarded by the Plt Ldrs to subordinate units in a timely manner?	Collect the DIS Signal PDUs containing the Operations Overlays sent by the Co Cmdr. Have STRIPES automatically note the time that the Overlay was originally transmitted. Have STRIPES log the time that the Overlay was retransmitted by the PLT Leaders. Compare the deltas to the standard.	Operations Overlay 1 1 <sup>st</sup> Transmittal: DTG 211015 1 <sup>st</sup> PL retransmitted within STD 2 <sup>nd</sup> PL retransmitted 5 minutes late 3 <sup>rd</sup> PL retransmitted within standard

The AAR system utilizes video equipment to capture the screen state of selected Appliqué terminals at all times; it allows an O/C to observe and record Appliqué activities, to flag them for future retrieval, and to attach voice annotations to the flagged events, as well as to review the flagged activities and cue them for presentation during the conduct of the AAR. Finally, it provides the O/C a display medium to present the selected Appliqué segments during the conduct of the AAR. The following figure (3.4.1.1-2) presents the components of the AAR Direct workstation.

**Figure 3.4.1.1-2. AAR Direct Workstation**

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Given the advent of improved video recording, compression, and storage technology, there are improved systems available for fielding an improved AAR System. Enhancements to this system are depicted on the following figure.



**Figure 3.4.1.1-3. Notional Block Diagram for Next Generation AAR Workstation**

Digitized storage of video and audio information vs. storing this information on videotape has many advantages and implications on real-time data observation as well as data retrieval that are not possible or difficult to achieve at the present time. Some of the advantages to this approach over the previous approach are:

- **Non-linear access.** Provides near real-time access to video along any point of the recorded exercise.
- **Greater Storage Capability.** Current system is limited to length of videotape. With new approach, the system limitation is the disk space. (Example: Estimates show that a 4Gb disk can store up to a 8 video sources of compressed video for a 3 hour exercise at 3 frames per second)
- **Flexible video display.** Use a single monitor to display a variety of sources. Operators will be able to select one or multiple screens to be displayed (split screen) on a single display. Number and type of screen(s) to be displayed is user selectable.
- **Smaller operating expense.** No longer requires the purchase of many videotapes. Disk can be backed up to tape (has much higher storage capacity for relative cost).

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- **Easily network AAR stations.** This may be useful if a coordinated AAR between O/C workstations is ever required. This system has the ability to retrieve video files from another AAR station.

Although system features are greatly enhanced, one must keep in mind the cost/performance tradeoff ratio. These system enhancements are currently being investigated and design modifications to the AAR Direct system are being prototyped. If costs are reasonable, for future procurements, this re-designed implementation should be considered, versus the initial "proof-of-concept" version that is currently fielded at Ft. Hood.

#### 3.4.1.2 Network reconfiguration to allow for isolated AARs.

In the current network configuration, the O/C rooms can be isolated from the rest of the site networks for conduct of AARs. This capability is required, since the replay of logged network traffic will interfere with any on-going simulations on the same network. The current site network configuration is shown in Figure 3.4.1.2-1. The problem with the current layout is that the O/C rooms do not have a Cell Adapter Unit (CAU) within their cell. When the O/C rooms are isolated for playbacks, the CAUs can no longer translate the DIS PDUs to SIMNET. This keeps the SIMNET systems, mainly the Stealth, from displaying any vehicles. To temporarily solve this issue, the STRIPES logger has been placed on the SIMNET side of the network, thus recording packets in SIMNET format. This means a translator is not required in the O/C Room's isolated network to display entities on the Stealth during a playback.

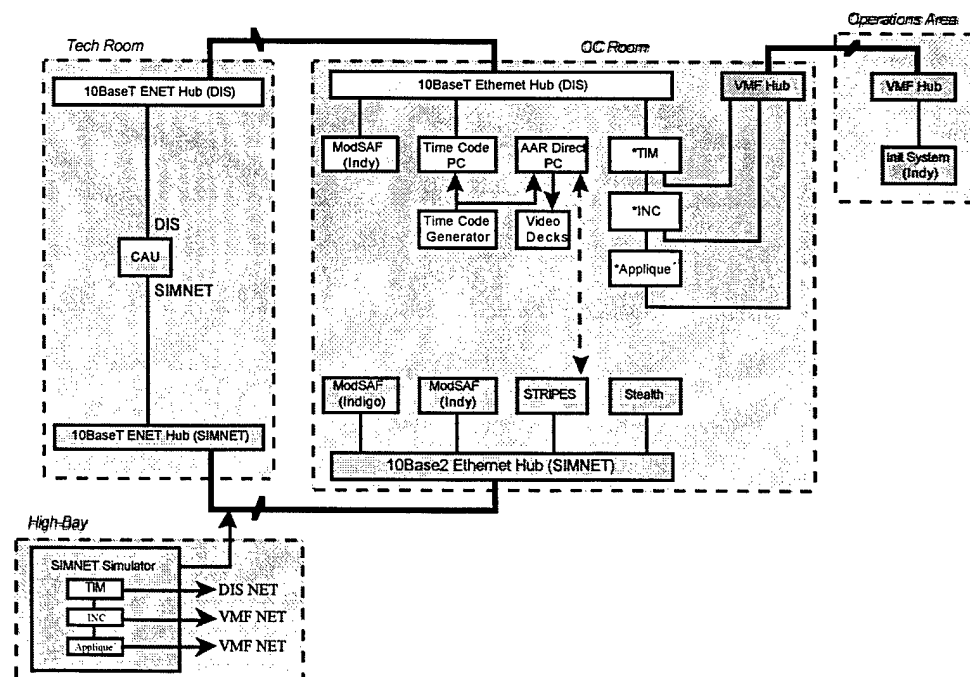


Figure 3.4.1.2-1. Existing Network Structure

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This is acceptable, for the time being; however, the STRIPES system must transition to the DIS network. This will allow for time synchronization, since the Timestamp PC packets are found only on the DIS LAN. Moving the STRIPES to the DIS LAN will also provide a "cleaner" solution for logging voice packets which originate as DIS packets from the TIMs and would require translation into SIMNET packets if the STRIPES were to remain on the SIMNET LAN. A recommended network structure is illustrated in Figure 3.4.1.2-2.

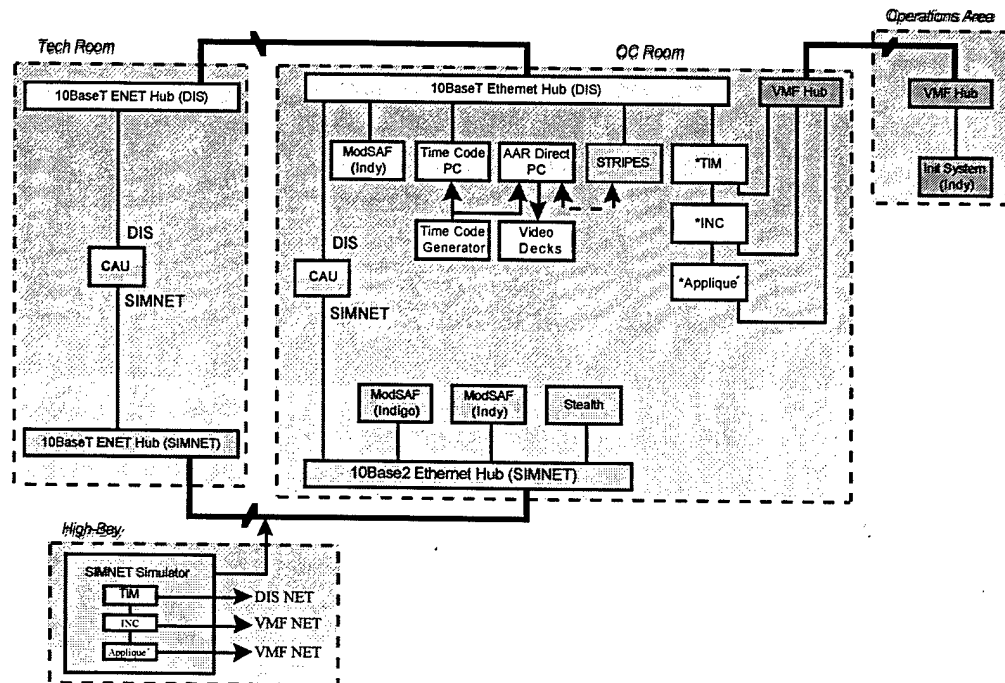


Figure 3.4.1.2-2. Suggested O/C Network Structure

A revised network topology would locate the CAUs at the individual O/C system level. This would place the DIS and the SIMNET O/C hubs in loopback mode (a simple switch throw on the network hubs), thus isolating the network for the conduct of AARs. There are some issues related to this revised topology. First, the Centrecom (hub brand name) should be modified to allow the O/C operators to easily switch the hub between loopback and non-loopback mode. This requires a simple remote switch. Second, with this configuration, the PLGR devices outside of the O/C rooms will not operate properly while the network is isolated. The SIMNET simulators will operate properly, but the PLGRs will not update the Appliqués until the CAU is on-line. To resolve this issue, another CAU would be required that resides external to the O/C network structure (as they currently exist).

The true issue is a requirement for additional CAUs. This could prove cost prohibitive, since the CAUs are currently hosted on Sun or SGI workstations. It would be of use to investigate the feasibility of porting the CAU system to a PC platform running in a UNIX environment. If Linux Operating System (OS) is used as a host OS for a PC version of the CAU, then there would be no hardware or software cost to the SIMNET/Janus Warfighting Facility, since

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there are several PCs that are spares and should be powerful enough to be used in this application.

### *3.5 Site Systems Maintainability*

There were two issues that were mentioned by site personnel regarding systems maintainability. Correcting these issues would help reduce down-time of systems. The two issues are:

- **Network cable reliability**
- **Alternative build method for TIMs, INCs, and Appliqués**

The 10BaseT network cable installed under the original EXFOR Delivery Order has a history of being unreliable. Problems with unreliable connectors and faulty lines were prevalent, but have somewhat stabilized lately. However, the network is susceptible to failure if cables are moved or disturbed. Replacing these cables with new ones or placing a 10BaseT backbone can help resolve this issue.

The current method for rebuilding or introducing a new TIM, INC, PLGR, Appliqué system is to utilize a fully operational unit of the same type and copy the entire disk of the good system to the new or faulty system. Although this is a fast process it requires the use of one good system and a separate or isolated Ethernet hub. An alternate method for loading damaged or new systems would be to utilize a system backup tape of a good system and one of the tape drives installed at the site. A spare Small Computer System Interface (SCSI) controller would need to be placed in systems that do not normally contain one (i.e. INC, Appliqué), the site has at least one spare SCSI controller. Boot disks which support the tape device could be made and at this point system backups and restores could be maintained without hindering site operations on the network.

## **4. Technology Transfer**

The SIMNET/Janus Warfighting Facility has provided the capability for training soldiers on the use of experimental systems (Appliqué and the Tactical Internet) in a combined arms Distributed Interactive Simulation environment. This is a unique capability and can be improved by expanding the breadth of the training network to include assets from Battalion and above. Another method for improving the SIMNET/Janus Warfighting Facility is by transferring technology from other simulation efforts that have created products that have potential application for SIMNET-Appliqué training.

### *4.1 Linking Command, Control, Communications, Computers, and Intelligence (C4I) Cells*

In the context of this document a C4I cell is a training or testing capability for Army Command, Control, Communications, Computers, and Intelligence that can be interconnected with live, virtual, or constructive simulations. Two C4I cells were examined to see if it was

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technically feasible to interconnect the SIMNET/Janus Warfighting Facility with these cells to provide an increased training capability. This type of linkage can add soldier-in-the-loop, entity level simulations to large scale exercises at levels significantly higher than Battalion. Of the two cells to be addressed, one is already in place and is located directly across the street from the SIMNET/Janus Warfighting Facility. This facility is the Consolidated Technical Support Facility (CTSF). The second possible C4I cell is the Force XXI Operations, Rehearsal and Test Support (FORTS) cell.

#### **4.1.1 Consolidated Technical Support Facility (CTSF)**

This section of the white paper discusses the potential for interconnectivity between the CTSF and the SIMNET/Janus Warfighting Facility. The CTSF is adjacent to the SIMNET/Janus Warfighting Facility, and if linked to SIMNET-Appliqué, can provide significant opportunities for digital exercises involving soldier-in-the-loop simulations (DIS / SIMNET) linked to Army Tactical Command and Control System (ATCCS) assets. The CTSF has several ATCCS suites communicating using LANs and actual radios. The CTSF is used for training soldiers at a Battalion and above level perspective. Janus is used as the simulation driver for the CTSF. Janus is a constructive simulation. If entity level, soldier-in-the-loop interactions were required, then a connection to the SIMNET-Appliqué systems must be developed. Here we provide two approaches to accomplish this linkage. One linkage uses an Appliqué system as a "gateway" between the CTSF and SIMNET-Appliqué, while the other approach uses a router for this interface.

The CTSF as well as the Janus/Appliqué systems use Appliqué in a mode where the Appliqué messages are transmitted (without communications effects) on a LAN, instead of using the TIM. The TIM is used to connect between Appliqués in SIMNET. These two methods of interconnecting Appliqués are not directly compatible. To resolve this lack of connectivity, a gateway from the CTSF's Appliqué LAN to the DIS network would have be provided. The two methods for implementing this gateway are our suggested approaches.

- 1.) **Appliqué Gateway.** This approach uses an Appliqué as a gateway between the CTSF's Appliqué networks and the SIMNET-Appliqué network. The Appliqué that acts as a gateway would be similar to an Appliqué operating in a Tactical Operations Center (TOC) with Army Battle Command System (ABCS) systems. This Appliqué system would be configured to communicate both on the its PPP interface as well as its Ethernet interface. It may be possible to connect the CTSF and the SIMNET C4I cells by configuring an Appliqué in a role that allows the system to pass CTSF traffic to SIMNET by receiving messages on the ABCS interface and passing them to SIMNET on the PPP interface. This implementation would require that the routing tables of the Appliqué for that role be configured so that all traffic destined for the CTSF would be routed to the LAN interface of the Appliqué and that all traffic destined for the SIMNET-Appliqué systems be routed through the PPP interface to the TIM/INC model.

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- 2.) **Router Interface.** It may be possible to link the two sites by configuring TIM/INC to match a role which is being used as a TOC Appliqué in the CTSF. This TIM/INC would be connected to what we refer to as a "Router" PC. The Router PC would route packets received from SIMNET's Appliqués directly to the Appliqués resident on the CTSF Appliqué LAN. This implementation would require a different configuration on the TIMs to account for the additional routes to nodes in the CTSF.

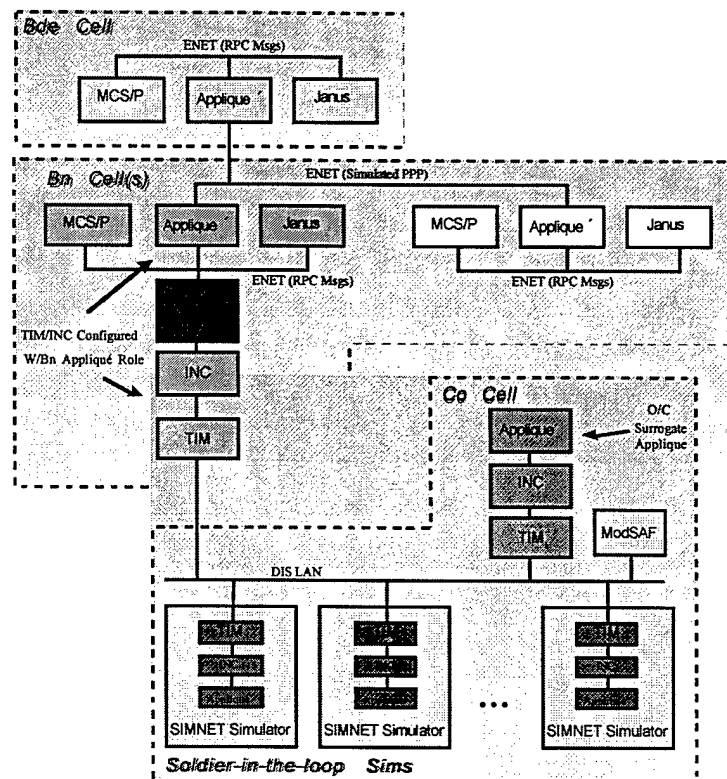


Figure 4.1.1-1. Options for CTSF Linkage to SIMNET/Appliqué

The implementations discussed above do not address voice communications between the SIMNET/Appliqué cell and the CTSF. Typically, personnel training in the CTSF use real SINCGARS radios for voice communications. Without a live/virtual gateway for digital voice, communications to the CTSF will require the use of a TIM in both facilities. It would be feasible to provide a few TIM nodes for voice communications between the commander's in the SIMNET/Appliqué side and the appropriate personnel in the CTSF.

#### 4.1.2 Force XXI Operations, Rehearsal, and Test Support (FORTS)

FORTS development will support Army FBCB2 during all phases of operational testing as well as many phases of developmental testing. FORTS is an on-going effort at Fort Hood by the U.S. Army's Test and Experimentation Command (TEXCOM). The FORTS team is conducting an Engineering Study to design the objective FORTS system. This system will provide a synthetic battlefield environment from dismounted soldier / individual vehicle to national C4I systems / assets. FORTS is required to properly stimulate users of FBCB2



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within a brigade without placing the entire brigade in the field. This means that messages from other than one command post and one company within that battalion must come from FORTS, as well as units adjacent to or above the brigade command post.

The FORTS Engineering Study is due to be completed by May 1997. The FORTS "Alpha" version will be developed, integrated, and tested between May and December of 1997. Since the design for the FORTS system is yet to be completed, we cannot make any detailed assessments as to the feasibility of linking FORTS products with the SIMNET/Janus Warfighting Facility. We have compiled some information about FORTS and have included pertinent information in this section. Where applicable, we have made some general observations about potential linkages between FORTS and the SIMNET/Janus Warfighting Facility.

FORTS requirements include:

- **Higher Level Architecture (HLA) Compliant and DIS Interoperable**
- **Entity-based (4000 - 5000 minimum)**
- **Stimulate FBCB2 and ATCCS Systems**
- **Use Tactical Communications / Realistic Communications Models**
- **Scenario Generation & Database Population to C4I Systems**
- **Test Visualization**
- **Leverage Key Technology**
- **Link to Other Systems**

The first objective of the FORTS Engineering Study is to identify an entity-based simulation model to stimulate FBCB2 and ATCCS systems. An entity-based simulation is required to replicate the information flows present for ATCCS and FBCB2 users at echelons brigade and below. Currently entity-based models used for brigade and below simulation support (Janus, ModSAF, etc.) do not include the simulation or stimulation components required to properly replicate information operations for the FBCB2 test. If linked with FORTS, the simulations within the SIMNET/Janus Warfighting Facility should be able to provide stimuli to FBCB2 at battalion and above. Data from this environment could be used to understand how the user interacts with the systems under test and how commander's and staff interact with FBCB2 information.

The U.S. Army Communications and Electronic Command (CECOM) has performed some initial research into providing Situational Awareness (SA) and Battle Command (BC) message servers that will support FORTS requirements. The SA and BC message servers would "fill the gap" and provide a complete virtual training environment that fully populates the virtual battlefield. The CECOM approach would augment crewed and surrogate simulators with SA and BC data for individual ModSAF entities. CECOM has proposed a two phased implementation. The first phase would generate SA VMF position update reports

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representing ModSAF entities during DIS exercises. The second phase would add the capability to send Battle Command messages from ModSAF.

## *4.2 Linking Simulation Cells*

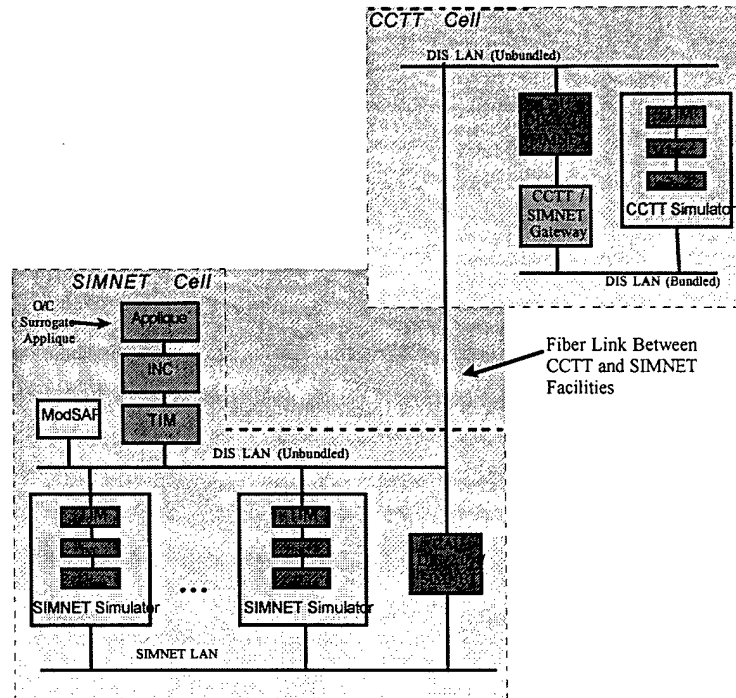
There are several simulation cells that have been considered for linkage with the SIMNET-Appiqué simulation cell. CCTT, BBS/ModSAF, and Janus/Appiqué have been addressed previously in the EXFOR Appiqué Implementation, Step 1 FAS (see references). These simulation cells were re-visited to determine what developments, if any, have been completed that may facilitate linkage to the SIMNET-Appiqué systems. An additional simulation cell located at Fort Hood is the Advanced Gunnery Training System (AGTS). We took a cursory look at AGTS to examine the feasibility of linking this system to the SIMNET/Appiqué simulation cell. A few notes were taken on this issue and are included below.

### **4.2.1 Close Combat Tactical Trainer (CCTT)**

The CCTT Quickstart facility is currently being populated with M1A1, M1A2, M2/M3, High Mobility Multipurpose Wheeled Vehicle (HMMWV), Dismounted Infantry (DI), M981 Fire Support Team - Vehicle (FIST-V), and M113A3 simulators. It is foreseeable that the CCTT assets and SIMNET devices can be configured in such a way that large-scale (Battalion and higher) Appiqué exercises could be conducted using both sites. This capability would require upgrading CCTT simulators and Tactical Operations Centers (TOCs) with Appiqué devices and the associated communications infrastructure (TIM/INC models). Ideally, we would provide a fully integrated solution for Appiqué installation into CCTT. This was not possible under the scope of this white paper study. The recommendation below is feasible, however, may not be the optimum final approach.

The approach taken for the SIMNET-Appiqué upgrade was a "strap-on" capability. In other words, the Appiqué installation on the SIMNET simulators was almost non-obtrusive in that it did not require extensive modifications to the simulator hardware and did not require any modifications to the simulator's software. As such, the upgrade approach is easily applicable to other simulation systems, like CCTT. We have identified a potential approach for adding Appiqué to a CCTT environment. A concept of operations and key areas to be addressed is provided for this implementation. The implementation is illustrated in Figure 4.2.1-1.

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**Figure 4.2.1-1. Suggested CCTT/Appliqué Implementation**

#### *4.2.1.1 Hardware*

The Appliqué implementation in CCTT would require that similar surrogate Appliqué hardware (SIMNET uses the V2 version of the Appliqué hardware) be installed internally in the CCTT crew shells. This should mimic the installation performed on the SIMNET devices. The CCTT systems have significantly higher physical fidelity than the SIMNET devices. This will allow for realistic installation of the simulated Appliqué hardware into the physical shell. Besides the physical installation into the simulator shell, the only other hardware issues are related to interfaces for voice communications. Radio (voice) interface is addressed as a separate section below.

#### *4.2.1.2 Protocols and Network Issues*

Importing the SIMNET/Appliqué solution to CCTT requires that several protocol and network issues be addressed. These issues are:

- **DIS 2.0.4 vs. DIS 2.0.3**
- **PDU Bundling**
- **Network Media (FDDI vs. Ethernet)**

CCTT systems communicate using DIS version 2.0.4 PDUs while the TIM and PLGR models use DIS version 2.0.3 PDUs. To port the TIM technology to CCTT, the TIM and PLGR systems would need to be converted to operate with the DIS version 2.0.4 protocols

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and to support the multicast and bundling schemes used in the CCTT. If TIM PCs were equipped with FDDI network adapters no additional networks would be required in the CCTT facility. The cost impact for equipping the TIMs with FDDI adapters varies depending on the implementation chosen. There are several ways to add fiber capability to the TIM systems which will not be addressed here. This implementation would require the use of two different network media at the CCTT facility. A fiber network is currently installed which carries all DIS version 2.0.4 PDUs for the CCTT systems.

Another possible solution for heterogeneous networks is the use of a LAN switch like the FORE Systems Powerhub 7000 LAN switch selected to upgrade the Core DIS Facilities (CDFs). LAN switches can separate the attached network segments into broadcast domains or Virtual LANs (VLAN). Using VLANs, the network traffic on one VLAN is not sent to devices on another VLAN (as is the case when all devices are on a common network). Therefore, one LAN switch can be used for multiple VLANs keeping the networks completely separated.

It is assumed that the CCTT/SIMNET translator is working and handles all DIS 2.0.4/SIMNET translations required. This implementation would utilize the CCTT/SIMNET translator for all SIMNET translations. The XCAU would not be used in conjunction with the CCTT/SIMNET translator, this would introduce duplicate entities on both networks.

#### *4.2.1.3 Radio (voice) communications*

Voice communications for CCTT devices operating with TIMs may be a bit complex. The TIM provides a Continuous Variable Slope delta (CVSD) voice encoder/decoder to allow transmission of voice radio traffic over the Tactical Internet. There are several ways that the TIM's digitized voice capability could be added to CCTT; however, these approaches may be costly in terms of the development efforts involved. The increase in fidelity over the existing CCTT voice functionality would likely not warrant the expense. A simple solution to this issue would be to keep the existing CCTT configuration and provide a hardware interface to the TIM from the CCTT crew station for push to talk signals. This would indicate to the TIM when a vehicle's radio is "keyed" and would allow for the effects of voice/data contention to be modeled.

A similar push-to-talk interface should be implemented in the SIMNET crew stations, since the SIMNET devices would have to use CB radios to communicate to CCTT systems (via a CCTT/SIMNET Gateway). This is a drawback to this solution, however, the CCTT system would not require extensive modifications. With a different solution, these modifications would probably be required to all CCTT radios (including TOCs, DI simulators, etc.).

#### *4.2.1.4 PLGR Model for CCTT*

Just as in the SIMNET/Appliqué implementation, PLGR models would be required for the Appliqué systems in CCTT. They are required for determination of own-vehicle position in

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the virtual world. The PLGR model must monitor the DIS network for Entity State PDUs (containing location data). Currently the PLGR model can monitor DIS 2.0.3 PDUs. For the solution discussed in this white paper, the PLGR would require a modification to be DIS 2.0.4 compatible.

#### **4.2.2 Advanced Gunnery Training System (AGTS)**

Several AGTS simulators have been fielded at Fort Hood and are currently operating in support of tank gunnery training. It is not unreasonable to believe that if the requirement were to ever arise, these systems could be linked in some way to the SIMNET/Janus Warfighting Facility to provide additional simulators for training, concept exploration, or other needs.

The Appliqué implementation and Tactical Internet simulations that were installed in the SIMNET/Appliqué system are very portable and can be "strapped on" to almost any DIS compliant simulator. This being the case, one could assume that the Appliqué implementation for SIMNET systems could be easily ported to other systems, like AGTS. If this were to ever be a requirement, there are issues that must be resolved. The primary issue is that the AGTS simulators at Fort Hood are not yet DIS compliant. DIS compliance is required for the Appliqué implementation provided for EXFOR training. Without DIS compliance, the PLGR and TIM simulations would not function. These simulations use the DIS Entity State PDUs to locate the own-vehicle on the virtual battlefield. The PLGR model uses the DIS Entity State PDU information to pass own-vehicle location data to the Appliqué (this allows Appliqué to display its own-vehicle icon on the Appliqué screen). The TIM uses the DIS Entity State PDU information to locate radios on the virtual battlefield and to calculate Message Completion Rates (MCRs) and transmission delays.

Terrain database, visual representation, environmental effects, acquisition ranges are among a few issues in the arena of basic simulation interoperability that must be addressed if AGTS and SIMNET are to operate in a close battle scenario. These issues will not be addressed in this white paper.

The AGTS radio simulation must be addressed as well. With some effort, the TIM could be modified to support the existing communications infrastructure within AGTS.

#### **4.2.3 Janus/Appliqué**

For the purposes of this white paper, we considered Janus/Appliqué a Simulation Cell, versus a C4I cell since the primary function of this cell is to conduct a "simulation" (Janus) that is augmented by a C4I system.

Interconnecting SIMNET-Appliqué with Janus can be achieved by the methods described in section 4.1.1 (CTSF) of this paper. Please refer to section 4.1.1 for this implementation.

## 5. Conclusion

The primary objective of the original EXFOR delivery order was to establish a distributed simulation training environment where EXFOR units could prepare and train for the TFXXI Army Warfighting Experiment (AWE) using the Appliqué system and components of the Tactical Internet. This virtual training environment was to represent real world conditions as much as possible, given the resources and time allotted for implementation. This objective has been achieved.

The objectives of the current EXFOR delivery order are to (1) maintain and enhance the EXFOR training capability, (2) investigate upgrades/fixes to the SIMNET/Appliqué training system, and (3) research potential linkages to other simulation and C4I cells. We have addressed objectives (2) and (3) in this white paper.

We have identified several "fixes" that would greatly enhance the quality of training and make training operations more efficient. Site personnel expressed that Exercise Administration was the primary issue that has hindered training in the past. Many of these issues can be resolved with relatively simple enhancements to the Initialization System that has become the primary tool for administering an Appliqué training exercise. We have recommended improvements to the Initialization System in this document.

Other improvements that may be considered important would require significant development efforts. The efforts that would most improve the training capabilities include the following:

- **Tactical Internet Stealth**
- **Situational Awareness and Battle Command (SA and BC) Message Servers or an Enhanced ModSAF-Appliqué Interface (FPE III legacy system)**

The Tactical Internet Stealth is a new concept and would require a detailed functional requirements specification before development could begin. It would, however, provide significant insight to a Tactical Internet exercise as well as providing Observer Controllers and Site Operations personnel with a valuable tool.

Perhaps the most significant weakness in the SIMNET/Appliqué implementation is the lack of a complete Situational Awareness picture for soldiers training in SIMNET/Appliqué. After reviewing the data provided in the EXFOR FAS (Phase I), an informed decision was made to not pursue what would have been a high risk, high cost implementation for a server approach that provides intelligent SA and BC information from ModSAF units. Several organizations have proposed to develop SA/BC Message Server(s) to fulfill this requirement. This is a needed addition, and should be completed as soon as resources are identified. A limited implementation for this capability is the ModSAF - Appliqué Interface developed under FPE III. This system should provide enhanced situational awareness, but presently

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has limitations that make it unusable in the Fort Hood SIMNET/Appliqué Facility environment.

An important lesson learned is that when transferring technology to the SIMNET/Janus Warfighting Facility, the implementation of the system must be carefully studied before it is inserted into the SIMNET/Appliqué training environment. As mentioned in the beginning of this paper, Exercise Administration is very challenging in the SIMNET/Appliqué environment. The facility and its personnel currently maintain a significant workload while preparing and executing a training exercise. Some of the enhancements recommended in this white paper should reduce this workload. However, until then, any modifications should be completely "system engineered", developed and tested in a similar virtual environment to assure that it can be implemented in the Fort Hood SIMNET/Appliqué environment.

## 6. Acronyms

The following is a list of acronyms used in this document.

AAR	After Action Review
ABCS	Army Battle Command System
ADST	Advanced Distribution Simulation Technology
ADST II	Advanced Distributed Simulation Technology II Program
AGTS	Advanced Gunnery Training System
ASAS	All Source Analysis System
ATCCS	Army Tactical Command and Control System
A/V	Audio/Visual
AWE	Advanced Warfighting Experiment
BBS	Brigade/Battalion Battle Simulation
BC	Battle Command
BCIS	Battlefield Combat Identification System
BDE	Brigade
BFV	Bradley Fighting Vehicle
BGP-4	Border Gateway Protocol Version 4
Bn	Battalion
Bn/TF	Battalion Task Force
C2	Command and Control
C3	Command, Control, and Communications
C4I	Command, Control, Communications, Computers, and Intelligence
CB	Citizens Band
CAU	Cell Adapter Unit
CCTT	Close Combat Tactical Trainer
Cdr	Commander
CECOM	US Army Communications Electronics Command



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CGI	Computer Generated Imagery
CIG	Computer Image Generator
CIU	Cell Interface Unit
Co	Company
COTS	Commercial Off-the-Shelf
CPU	Central Processing Unit
CTSF	Consolidated Technical Support Facility
CVSD	Continuous Variable Slope Delta
DCE	Distributed Computing Environment
DI	Dismounted Infantry
DIS	Distributed Interactive Simulation
EPLRS	Enhanced Position Location Reporting System
EPLRS NCS	EPLRS Net Control Station
EXFOR	US Army Experimental Force
FAS	Feasibility Analysis Study
FBCB2	Force XXI Battle Command - Brigade and Below
FDDI	Fiber Distributed Data Interface
FIST-V	Fire Support Team - Vehicle
FORTS	Force XXI Operations, Rehearsal, and Test Support
FXXI	Force XXI
GFE	Government Furnished Equipment
GPS	Global Positioning System
GUI	Graphic User Interface
HLA	Higher Level Architecture
HMMWV	High Mobility Multipurpose Wheeled Vehicle
IG	Image Generator
INC	Internet Controller
INS	Inertial Navigation System

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I/O	Input/Output
IP	Internet Protocol
LAN	Local Area Network
LCD	Liquid Crystal Display
LHN	Long Haul Network
LOS	Line Of Sight
L/V	Live/Virtual
MB	Megabytes
MBBL	Mounted Battlespace Battle Laboratory, Ft. Knox, Kentucky.
MBT	Main Battle Tank
MCC	Management Command & Control
MCR	Message Completion Rate
MCS	Maneuver Control System
ModSAF	Modular Semi-Automated Forces
MSE	Mobile Subscriber Equipment
NTC	National Training Center, Ft. Irwin, CA
O/C	Observer/Controller
OPFOR	Opposing Forces
OPORD	Operations Order
OPSIN	Opstate Interpreter
PC	Personal Computer
PDU	Protocol Data Unit
PLGR	Precision Lightweight Global Positioning System (GPS) Receiver
Plt	Platoon
PM TRADE	US Army Project Manager Training Devices
PO	Persistent Object
PVD	Plan View Display
RAM	Random Access Memory

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ROM	Rough Order of Magnitude
RPC	Remote Procedure Call
SA	Situational Awareness
SAFOR	Semi-Automated Forces
SCO	Santa Cruz Operating System
SCSI	Small Computer System Interface
SGI	Silicon Graphics Inc.
SIMNET	Simulation Network
SINGARS	Single Channel Ground and Airborne Radio System
SINGARS SIP	SINGARS Improvement Program
SMI	Soldier-Machine Interface
STOW	Synthetic Theater of War
STRICOM	US Army Simulation, Training and Instrumentation Command, Orlando, FL
STRIPES	Simulation TRaining Integrated Performance Evaluation System
TBD	To Be Determined
TCP	Transmission Control Protocol
TEXCOM	US Army Test and Experimentation Command
TF	Task Force
TFXXI	Task Force XXI
TI	Tactical Internet
TIM	Tactical Internet Model
TIS	Tactical Internet Stealth
TM	Team
TMG	Tactical Multinet Gateway
TOC	Tactical Operations Center
TPN	Tactical Packet Network
TRAC	US Army TRADOC Analysis Command
TRAC-WSMR	US Army TRADOC Analysis Command - White Sands Missile Range

February 7, 1997

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TRADOC	US Army Training and Doctrine Command, Ft Monroe, VA
TSM	TRADOC System Manager
TSM-FXXI	TRADOC System Manager - Force XXI
TSP	Training Support Package
TTP	Tactics, Techniques, and Procedures
UDP	User Datagram Protocol
URN	Unit Routing Number
V2	Ruggedized Version of Appliqué Hardware - (uses a PC platform)
V3	Militarized Version of Appliqué Hardware- (uses a PC platform)
VLAN	Virtual Local Area Network
VMF	Variable Message Format

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## **Appendix A, White Paper Briefing Package**

The following briefing slides support the information provided in the White Paper.

# White Paper Briefing

## *Future Improvements for the Force XXI Battle Command - Brigade and Below Fort Hood SIMNET/Janus Warfighting Facility*



Advanced Distributed Simulation Technology II  
(ADST II)

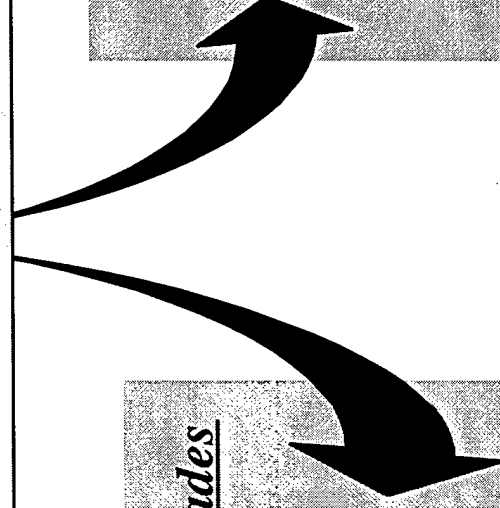
Prepared for

NAWCTSD/STRICOM  
12350 Research Parkway  
Orlando, FL 32826-3224  
N61339-96-D-0002

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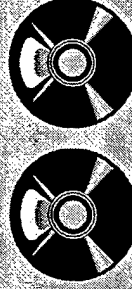
# White Paper Objectives

To identify requirements for simulation transfer to the Ft. Hood SIMNET/Applicé Training Facility

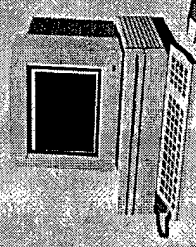


## Identify Potential Upgrades

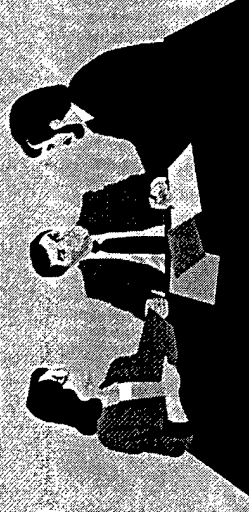
*Software*



*Hardware*



## Identify and Address Technical Issues



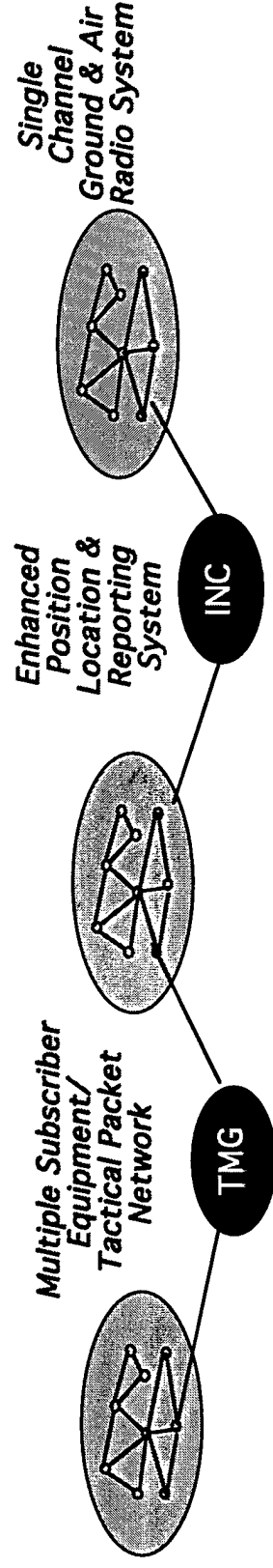
# Technical Issues

- Exercise Administration
- Tactical Internet Model
  - Voice Communications
- PLGR Model
- Simulation Support Systems
- Site Systems Maintainability



# Technology Transfer

- Linking C4I Cells
  - Consolidated Technical Support Facility
  - Force XXI Operations, Rehearsal, and Test
- Linking Simulation Cells
  - Close Combat Tactical Trainer (CCTT)
  - Advanced Gunnery Training System (AGTS)
  - Janus / Appliqué

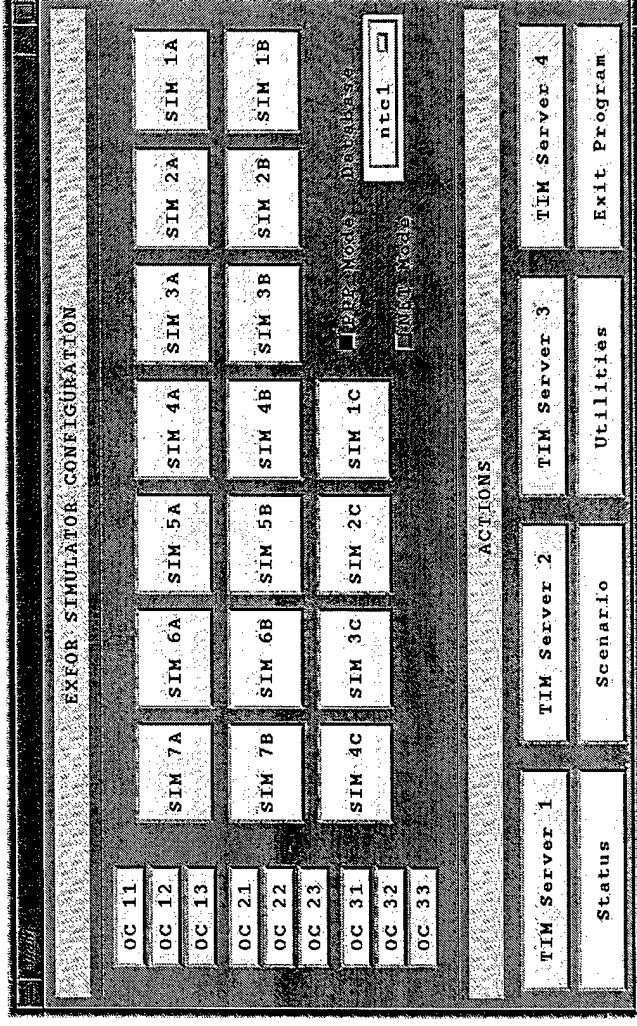


# Exercise Administration

- Exercise Initialization
  - Make Initialization System more user friendly
  - Refine “scenario saving” capability
  - Provide electronic data transfer between TSP files and Initialization System

# Exercise Initialization

- Make Initialization System more user friendly
- Refine “scenario saving” capability
- Provide electronic data transfer between TSP files and Initialization System

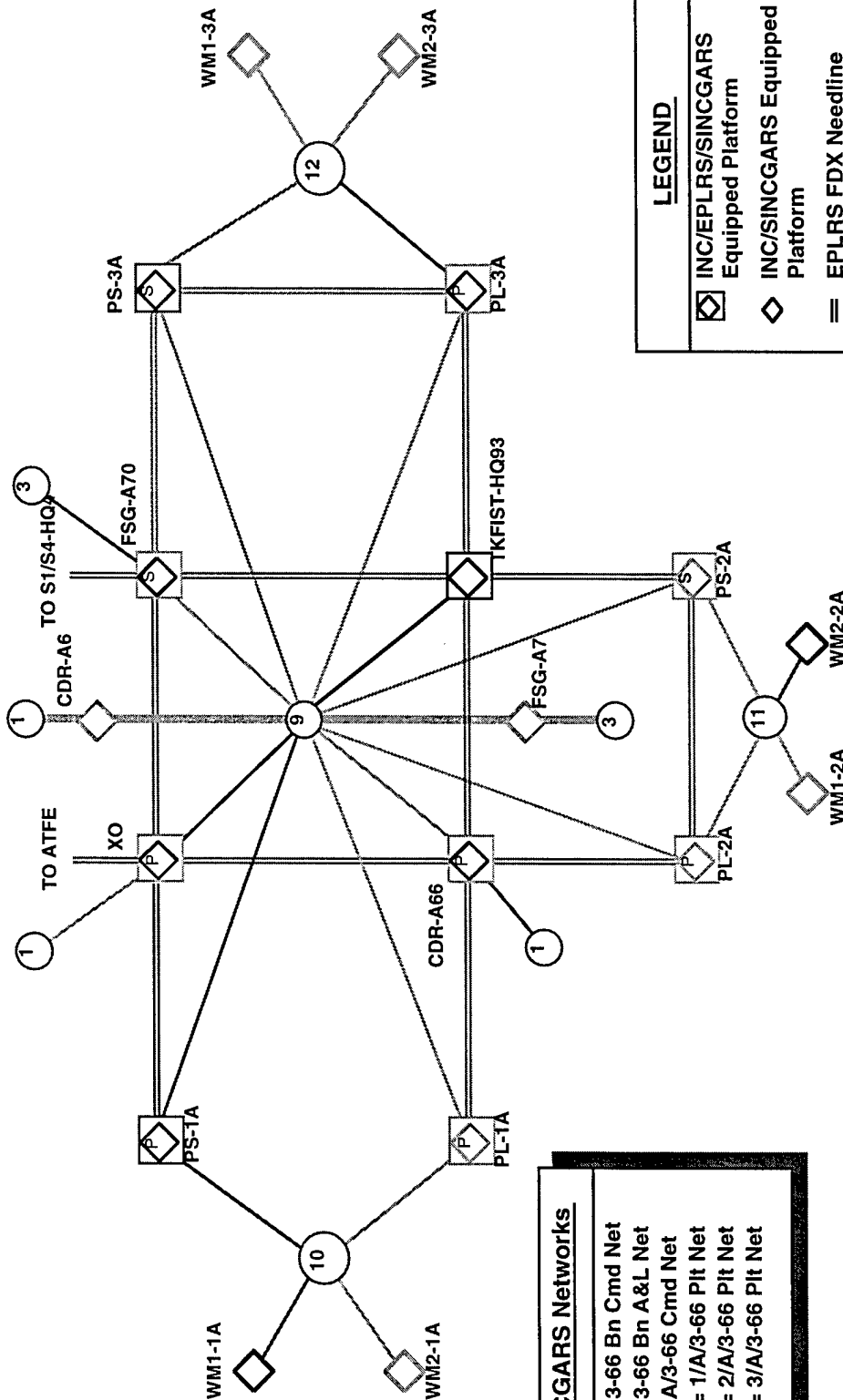


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# Exercise Management

- Enhance Initialization System to provide fault isolation and fault recovery
- TIM Radio Stealth that can provide active/inactive communication links

# Tactical Internet Stealth



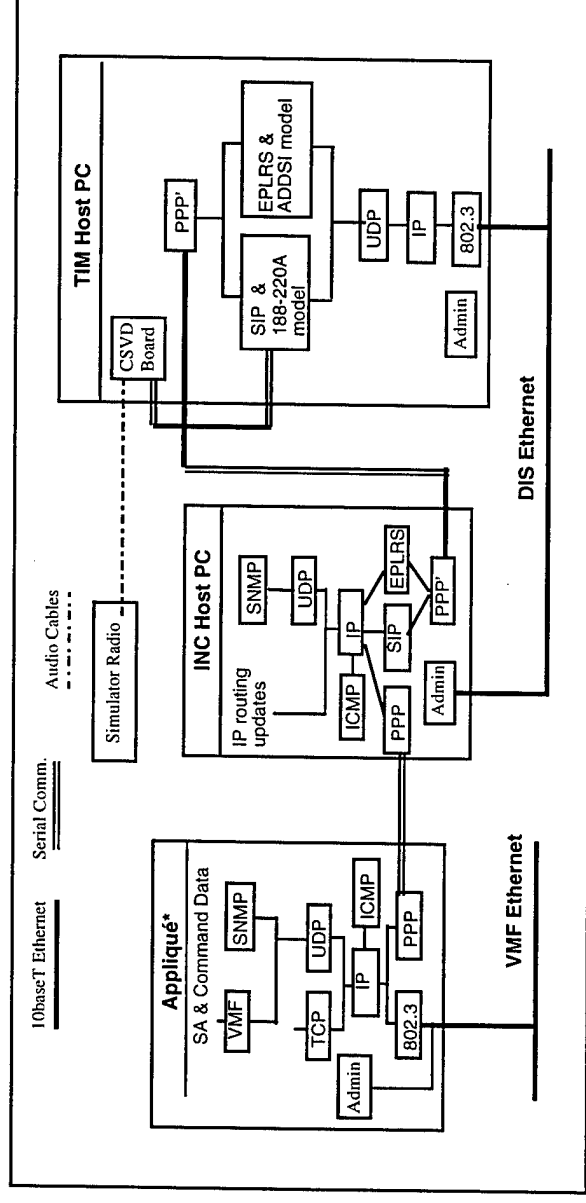
SINGGARS Networks	
1	= 3-66 Bn Cmd Net
3	= 3-66 Bn A&L Net
9	= A/3-66 Cmd Net
10	= 1/A/3-66 Plt Net
11	= 2/A/3-66 Plt Net
12	= 3/A/3-66 Plt Net

Green	=Operational and idle comms link
Violet	=Active comms link (transmit)
Orange	=Operational, link affected by comms model
Black	=Uninitialized system
Red	=System Failure

LEGEND	
	INC/EPLRS/SINGGARS Equipped Platform
	INC/SINGGARS Equipped Platform
	EPLRS FDX Needline
	SINGGARS Net

# Tactical Internet Model

- Add Receiver PDUs
- Assure that TIM is DIS compliant
- Investigate utility of SMI Faceplates for TIM
- Amplifier circuit to boost TIM voice signal has not been implemented



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## PLGR Model

- Add remote re-synchronization in case of failure
- Add remote PLGR position reporting

*Simple system fixes that save time  
for Technicians and Operations Personnel*

# Training Support Systems

- Data Collection and Presentation
- After Action Review
  - OC Network cannot be easily isolated during AARs
  - Provide increased robustness to AAR Direct A/V recording system



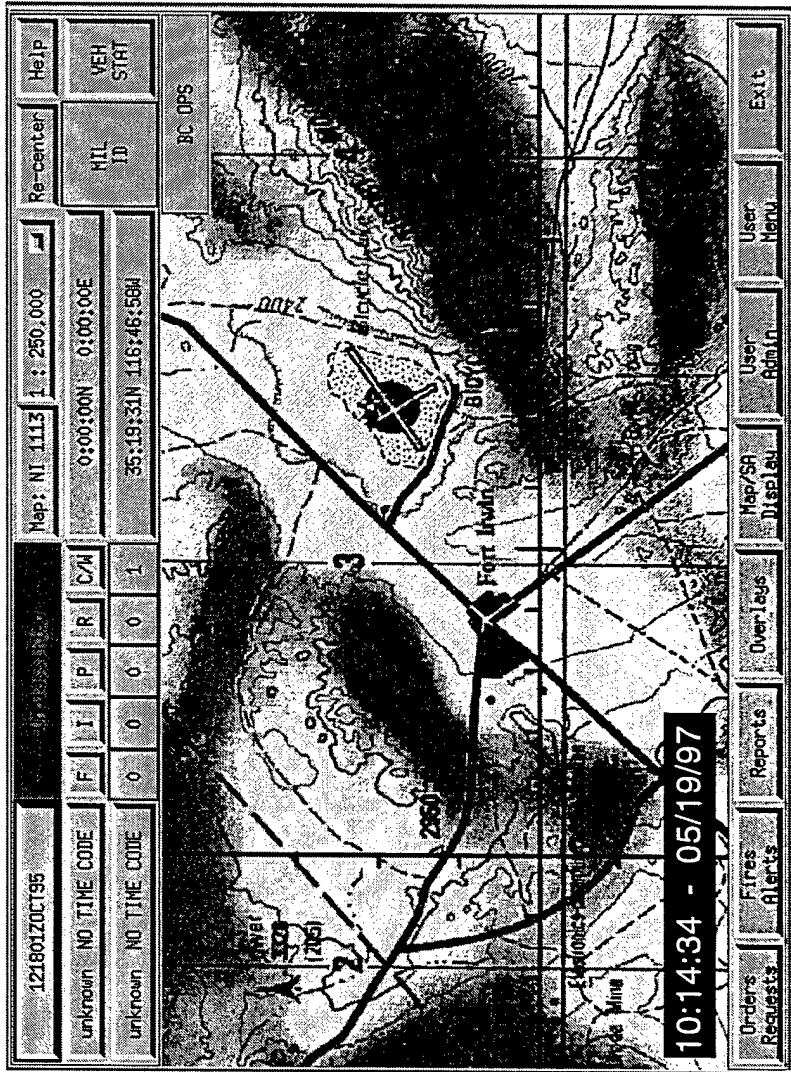
# Data Collection and Presentation

- STRIPES does not log CB (RF) Networks
  - Port ModSAF voice logging capability to STRIPES
- Develop Automated AAR tools that are applicable to 'digital' TSPs
- Add timestamp directly to video screen

# Automated C2 Data Analysis

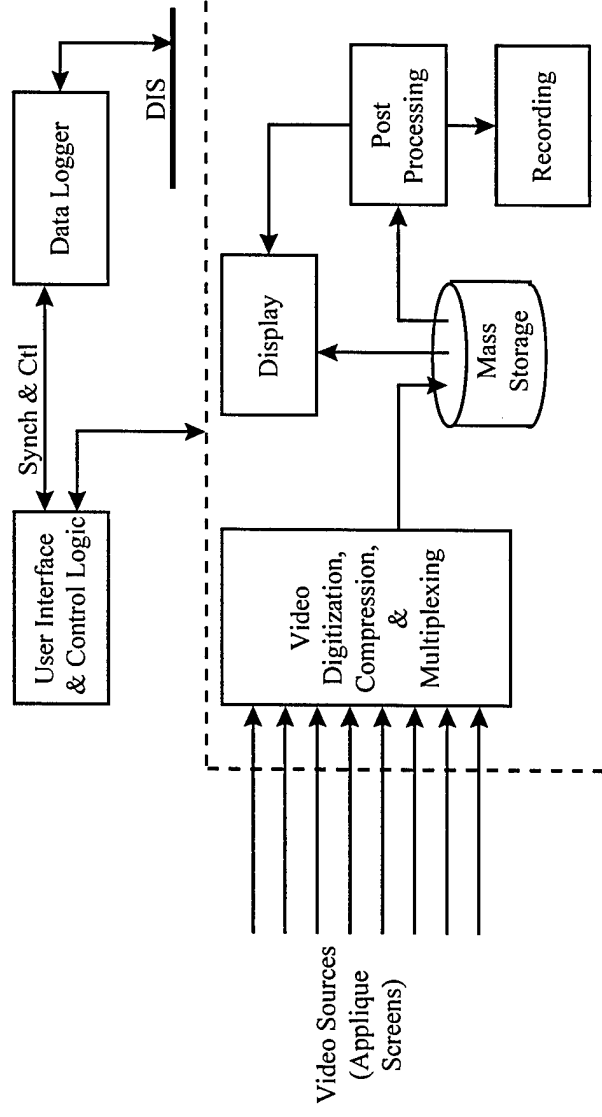
Data Element	Method of Collection	Sample Data
How accurate were the Spot reports sent by 2 <sup>nd</sup> PLT LDR of Alpha Company?.	Collect all Spot Reports sent by 2 <sup>nd</sup> PLT LDR's Appliqué on the DIS network. Examine the reported locations and vehicle types for the observed vehicles for all Spot Reports. Compare this information to the "ground truth" data found in the DIS PDUs and automatically determine the deltas.	Bumper No: A21 Spot Report Accuracy: 90% Spot Reports Sent: 10 Spot Reports within tolerance: 9 Erroneous Spot Reports: 1 Msg 1: DTG 211014 Error: Reported observed T72, actual vehicle was a BMP
Was the Operations Overlay (originally sent by an O/C room Appliqué, acting as a Company Commander) forwarded by the Plt Ldrs to subordinate units in a timely manner?	Collect the DIS Signal PDUs containing the Operations Overlays sent by the Co Cmdr. Have STRIPES automatically note the time that the Overlay was originally transmitted. Have STRIPES log the time that the Overlay was retransmitted by the PLT Leaders. Compare the deltas to the standard.	Operations Overlay 1 1 <sup>st</sup> Transmittal: DTG 211015 1 <sup>st</sup> PL retransmitted within STD 2 <sup>nd</sup> PL retransmitted 5 minutes late 3 <sup>rd</sup> PL retransmitted within standard

# Video Time Stamping



*Provides for easier event tracking  
for take home packages*

# After Action Reviews

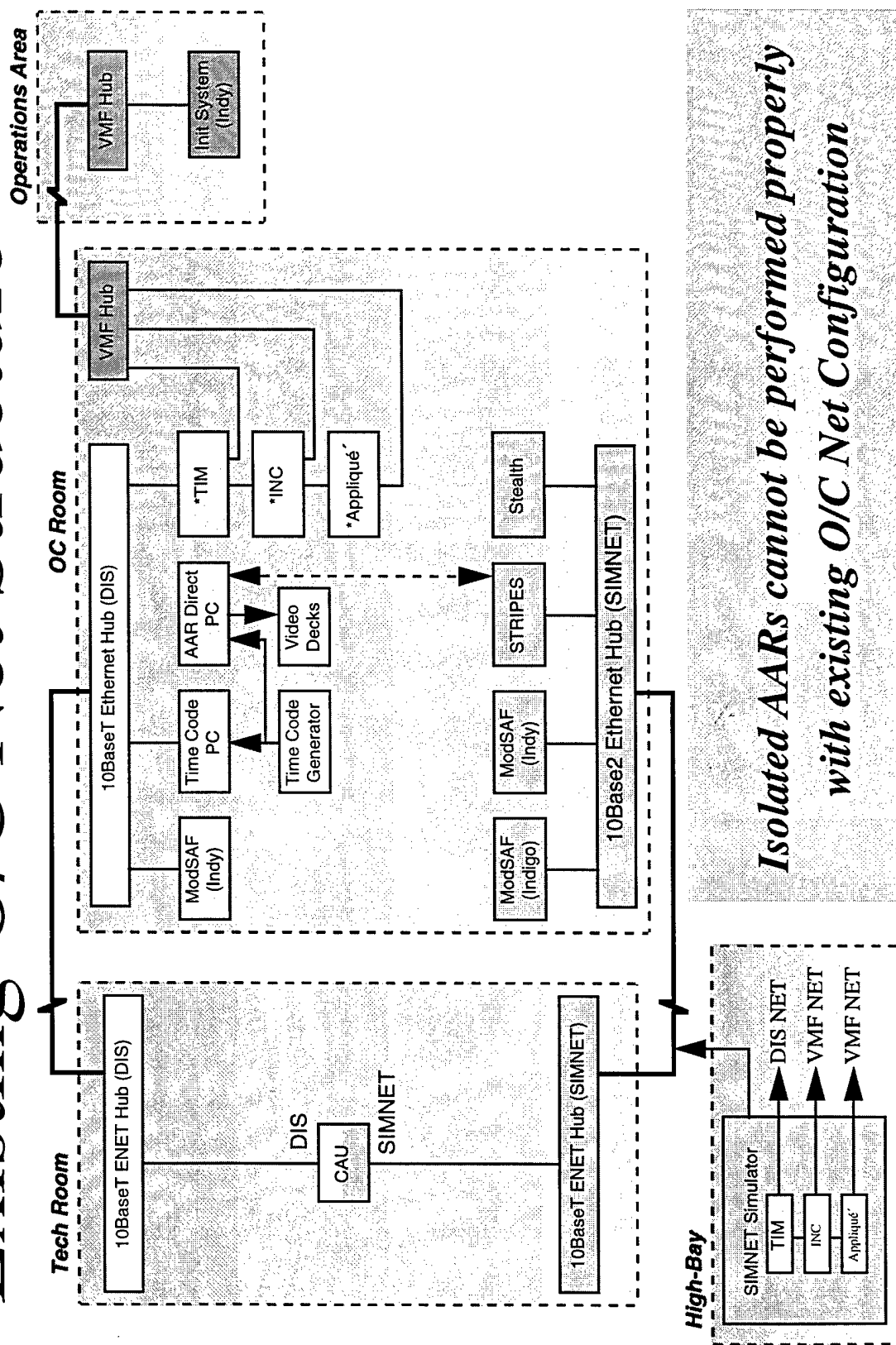


- Improved A/V AAR Technology

- Non-linear access to stored video data
- Greater storage capability
- Smaller operating expense
- Networked AARs
- Flexible display options (single or multiple displays)

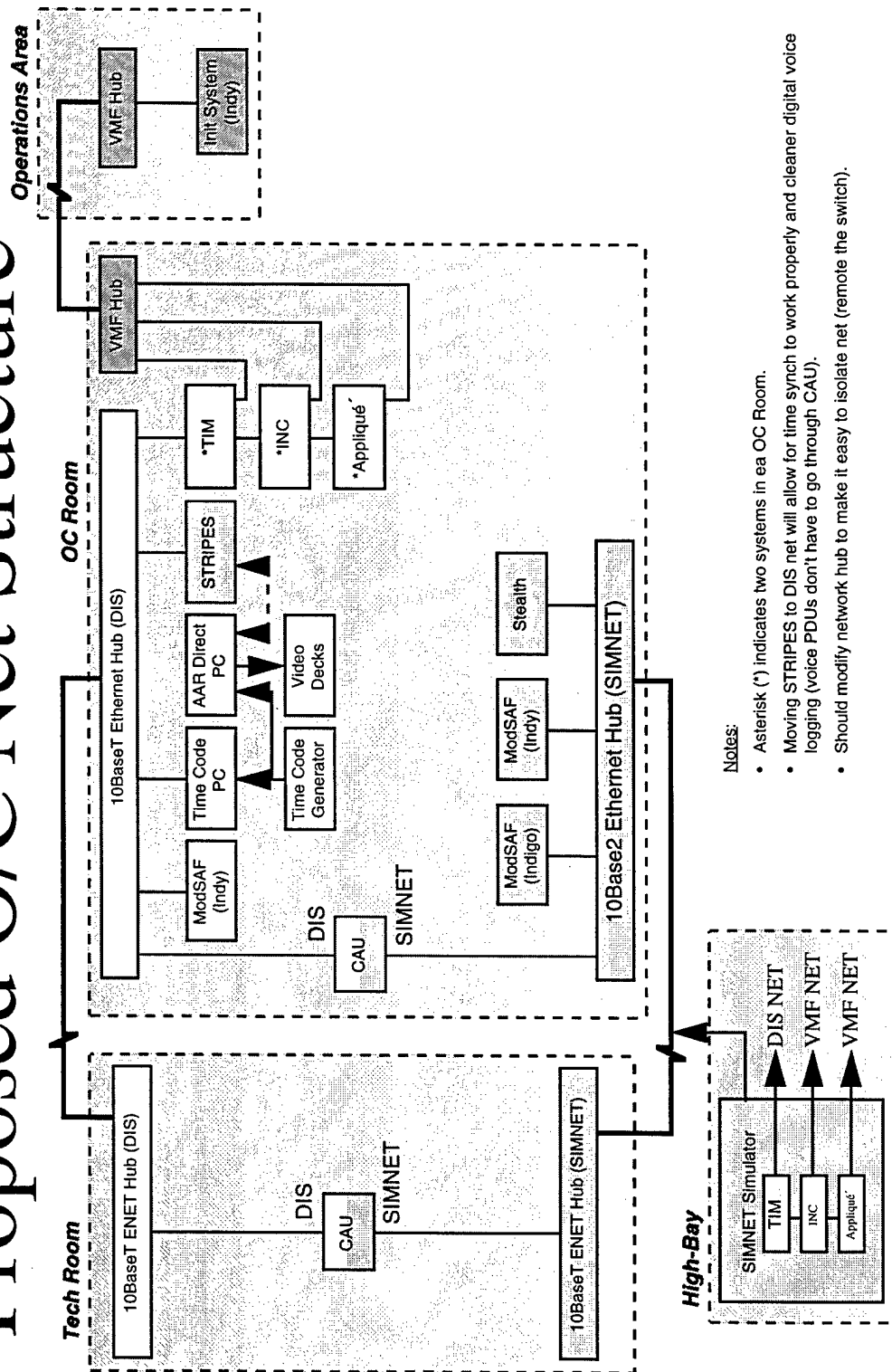
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# Existing O/C Net Structure



*Isolated AARs cannot be performed properly  
with existing O/C Net Configuration*

# Proposed O/C Net Structure



*Site networks should be reconfigured for Isolated AARs*

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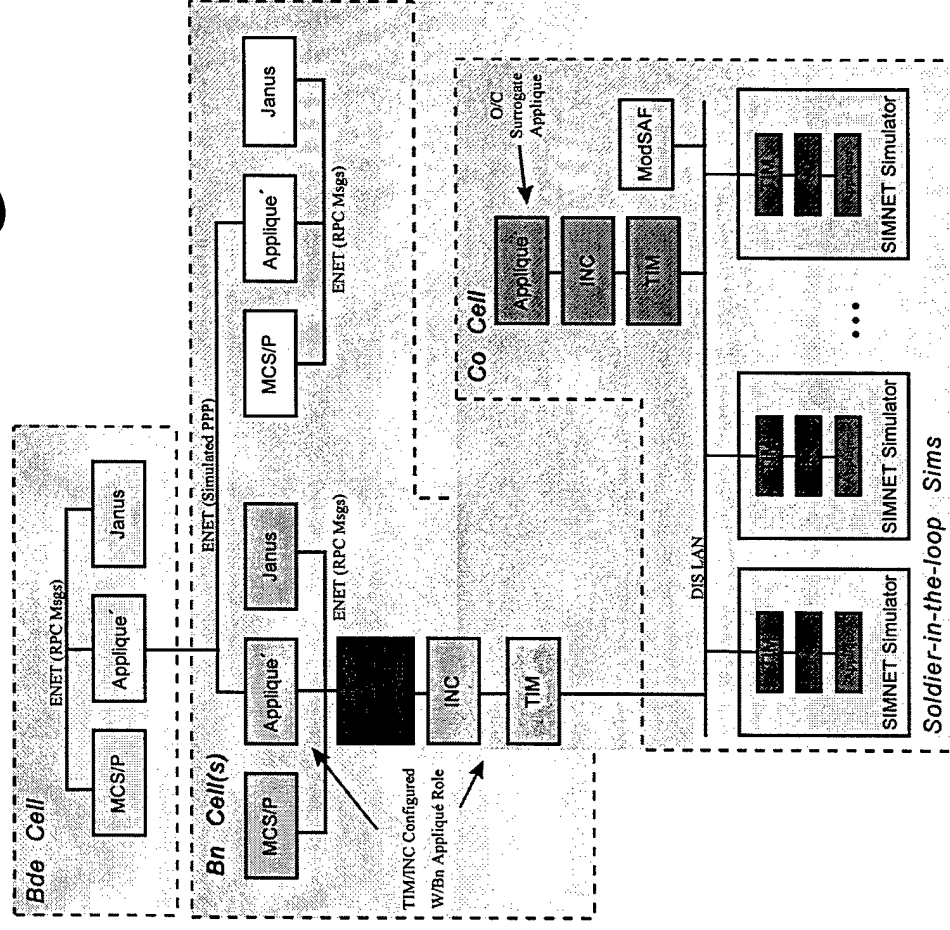
# Site Systems Maintainability

- Network cable reliability is an issue
  - Recommend replace cables or place 10Base-2 backbone into site
- Provide an alternative build method for TIMs, INCs, and Appliqués
  - Current build method is via network connection
  - Current system does not allow for re-builds during exercises (techs must wait)
  - New method, (using tape load via SCSI) allows for system re-builds while exercises are on-going (saves time)





# CTSF Linkage



*Use Applique Router or Routing PC to interconnect cells*

# FORTS

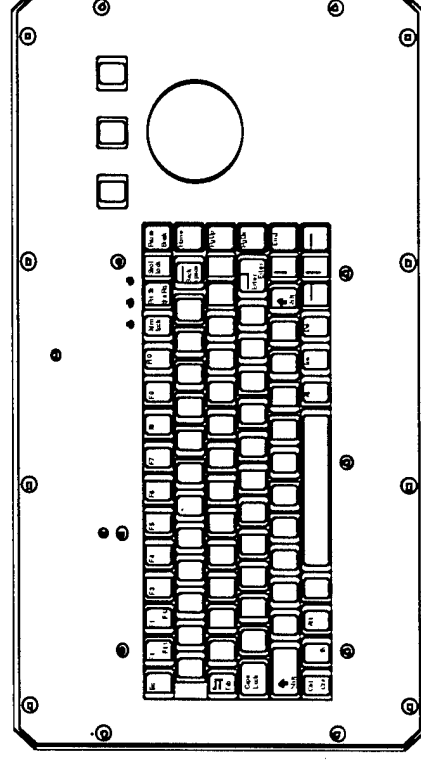
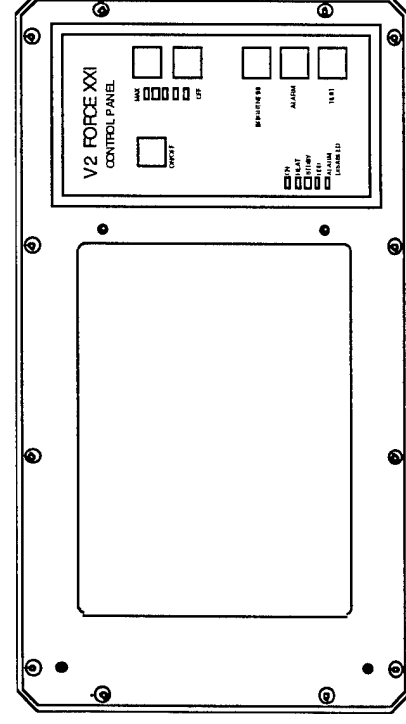
- FORTS is in early concept developments stage
- FORTS will be able to leverage from SIMNET / Appliqué products and lessons learned
- FORTS Key Requirements
  - HLA Compliant and DIS Interoperable
  - Entity based (4000 - 5000 minimum)
  - Stimulate FBCB2 and ATCCS Systems
  - Use Tactical Comms / Realistic Comms Models
  - Test Visualization
  - Leverage Key Technology
  - Link to Other Systems
- CECOM SA/BC Server being proposed for use in FORTS

# CCTT/Appliqué

- Investigated methods for “low-fidelity” and “low-cost” linkage between CCTT using existing SIMNET/Appliqué approach
- Also investigated connectivity between SIMNET/Appliqué and the recommended CCTT/Appliqué approach
- Key Issues
  - Hardware
  - Protocols and Networks
  - Radio (voice) communications
  - PLGR Model

# CCTT/Appliqué - Hardware

- Use similar hardware approach as in SIMNET/Appliqué
  - Use mockup of V2 Appliqué (Display and Keyboard)
- “Strap-on” approach will minimize modifications to CCTT crewshell

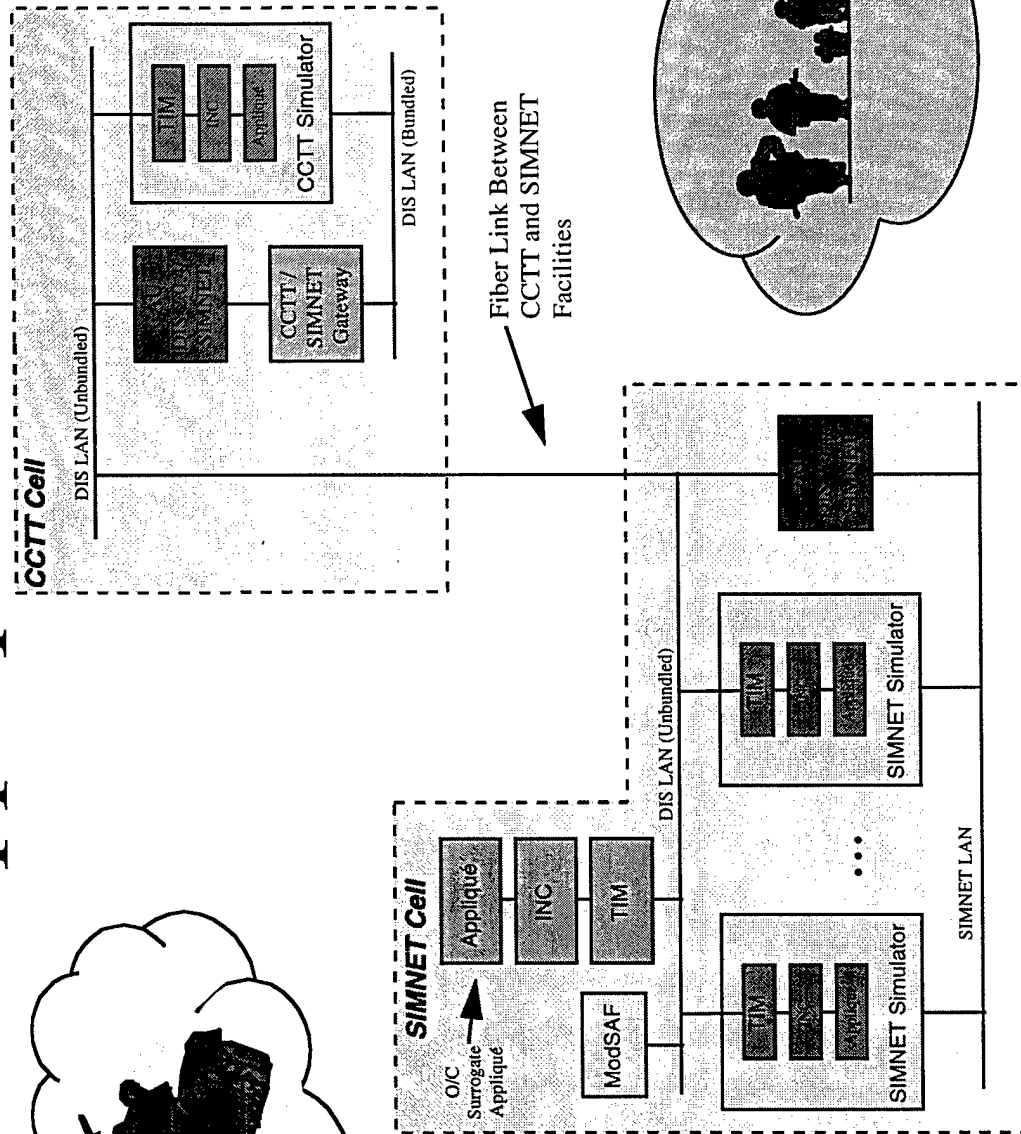
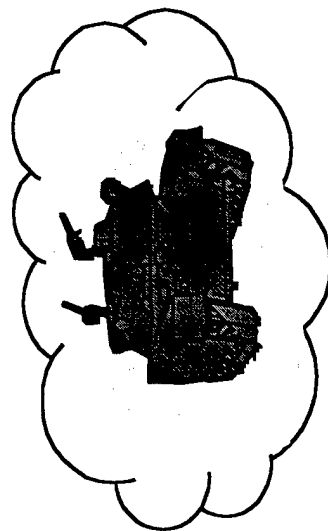


# Protocols and Network Issues

	CCTT	SIMNET, TIM, PLGR
Network Protocol	DIS v2.0.4	DIS v2.0.3 (SIMNET using CAU)
Network Media	FDDI	Ethernet
PDU Handling	CCTT PDU Bundling	Unbundled PDUs
Radio Traffic	CCTT SINGARS	Tactical Internet (SIP/EPLRS)

- Upgrade TIM and PLGR to be DIS 2.0.4 compatible
- Use CCTT/SIMNET gateway for voice comms (CCTT SINGARS/SIMNET CBs)
- Provide for voice/data contention effects
- Investigate use of LAN switches and VLANs

# CCTT/Appliqué Architecture



## Summary

- The SIMNET/Appliqué Training System is a very complex system that makes exercise administration very difficult
  - Initialization System greatly reduces the impact of this issue
  - Init system upgrades can ease initialization and management of exercises
- Most other technical issues are minor and can be corrected with a relatively low LOE
- Recommend development of a Tactical Internet Stealth capability

## Summary (con't)

- Connecting to C4I cells can be achieved by leveraging upcoming development efforts (i.e., FORTS)
- Connecting the CCTT simulation cell to SIMNET/  
Appliqué is feasible
  - “Strap-on” upgrade kit is feasible for short term applications
  - Integrated approach will provide best long-term, but will require substantial development time and may be more costly
  - Training requirement and Appliqué Life-cycle should be considered when making decision



## Summary (concluded)

- SIMNET/Appliqué training systems are unique, requiring careful consideration of many issues before a decision to insert new technology is made
  - Assure that the technology being inserted will support the EXFOR training mission (is it something that is needed and will enhance training)
  - Assure that the technology is usable “as is” within the context of the EXFOR training environment
    - If not, make modifications as required to assure that
      - Site personnel can easily initialize, operate, and maintain system
      - Technology is compatible with existing systems
  - Short-term technology insertion should focus on easing burden on operations, technical, and administrative personnel